



452320

REGION 5 RAC2

REMEDIAL ACTION CONTRACT FOR

Remedial, Enforcement Oversight, and
Non-Time Critical Removal Activities at Sites of Release
or Threatened Release of Hazardous Substances in Region 5

QUALITY ASSURANCE PROJECT PLAN

Remediation of Groundwater and
Dense Nonaqueous Phase Liquid

OMC Plant 2 Site

Waukegan, Illinois

WA No. 074-RARA-0528/ Contract No. EP-S5-06-01

February 2011

BACK
Returned to
Submitter "ONLY"

PREPARED FOR

U.S. Environmental Protection Agency



PREPARED BY

CH2M HILL

Ecology and Environment, Inc.

Environmental Design International, Inc.

Teska Associates, Inc.

FOR OFFICIAL USE ONLY

QUALITY ASSURANCE PROJECT PLAN

**OMC PLANT 2 SITE
Waukegan, Illinois**

Remediation of Groundwater and Dense Nonaqueous Phase Liquid

WA No. 074-RARA-0528/Contract No. EP-S5-06-01

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- 2 Sample Location Types – Sample Identification

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- 4 TCE DNAPL Delineation
- 5 PCB DNAPL Delineation

Appendixes

- A Field Operating Procedures
- B Data Management Plan

Acronyms and Abbreviations

APM	Assistance Program Manager
CLP	Contract Laboratory Program
cis-1,2-DCE	cis-1,2-dichloroethene
COC	contaminant of concern
DNAPL	dense nonaqueous phase liquid
DQO	data quality objective
EISB	in situ bioremediation
FOP	field operating procedure
ISSM	in situ soil mixing
MS/MSD	matrix spike/matrix spike duplicate
µg/L	micrograms per liter
mg/L	milligrams per liter
MNA	monitored natural attenuation
ORP	oxidation-reduction potential
PCB	polychlorinated biphenyl
PM	Program Manager
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
RAC	remedial action contract
SOP	standard operating procedure
SOW	statement of work
SSC	Site Safety Coordinator
TCE	trichloroethene
TOC	total organic carbon
UFP	Uniform Federal Policy
USEPA	United States Environmental Protection Agency
VFA	volatile fatty acid

VOC volatile organic compound

ZVI zero-valent iron

Worksheet #1—Title and Approval Page

(Uniform Federal Policy [UFP] Quality Assurance Project Plan [QAPP] Section 2.1)

Site Name/Project Name: OMC Plant 2 Site

Site Location: Waukegan, IL

Document Title: Quality Assurance Project Plan (QAPP) OMC Plant 2 Site

Lead Organization: United States Environmental Protection Agency (USEPA)

Preparer's Name and Organizational Affiliation: Adrienne Korpela / CH2M HILL

Preparer's Address, Telephone Number, and E-mail Address: 135 South 84th Street, Suite 325; Milwaukee, WI 53214; 414-272-2426; Adrienne.Korpela@CH2M.com

Preparation Date (Day/Month/Year): 05/08/2009

Investigative Organization's Project Manager/Date: _____

Signature



Printed Name/Organization: Jewelle Keiser / CH2M HILL _____

Investigative Organization's Project QA Officer/Date: _____

Signature



Printed Name/Organization: Jewelle Keiser / CH2M HILL _____

Lead Organization's Project Manager/Date: _____

Signature

Printed Name/Organization: Kevin Adler / USEPA

Approval Signatures/Date: _____

Signature

Printed Name/Title: TBD / USEPA Quality Assurance Reviewer

Approval Authority: USEPA Region 5

Laboratory Director /Date: _____
Signature

Printed Name/Title: TBD / Laboratory Director

Laboratory Quality Assurance Manager/Date: _____
Signature

Printed Name/Title: TBD / Laboratory Quality Assurance Manager

Document Control Numbering System: OMC-OU4-R0

Worksheet #2—QAPP Identifying Information

(Uniform Federal Policy [UFP] Quality Assurance Project Plan [QAPP] Section 2.2.4)

Site Name/Project Name: OMC Plant 2 Site

Title: OMC Plant 2 Site – QAPP

Site Location: Waukegan, IL

Revision Number: 0

Site Number/Code: ILD000802827

Revision Date: December 2009

Operable Unit: 4

Contractor Name: CH2M HILL

Contractor Number: EP-S5-06-01

Contract Title: Remedial Action Contract 2

Work Assignment Number: 053-RDRD-0528

1. Identify regulatory program:

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980, commonly known as Superfund

2. Identify approval entity:

USEPA Region 5

3. The QAPP is (select one): ☐ Generic ☒ Project Specific

4. List dates of scoping sessions that were held: February 6, 2009

5. List dates and titles of QAPP documents written for previous site work, if applicable:

Title	Approval Date
Quality Assurance Project Plan, OMC Plant 2 Remedial Investigation	January 2005
Supplemental Quality Assurance Project Plan, OMC Plant 2 Pilot Study Test	December 2006
Quality Assurance Project Plan, OMC Plant 2, Remedial Action	June 2008

6. List organizational partners (stakeholders) and connection with lead organization:

USEPA Region 5 (lead organization)

IEPA (state agency)

City of Waukegan (property owner)

CH2M HILL (contractor)

7. List data users:

USEPA, CH2M HILL

8. If any required QAPP elements and required information are not applicable to the project, then circle the omitted QAPP elements and required information on the attached table. Provide an explanation for their exclusions below:

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information	Crosswalk to Related Documents
Project Management and Objectives		
2.1 Title and Approval Page	- Title and Approval Page	Worksheet #1
2.2 Document Format and Table of Contents	- Table of Contents	Worksheet #2
2.2.1 Document Control Format	- QAPP Identifying Information	
2.2.2 Document Control Numbering System		
2.2.3 Table of Contents		
2.2.4 QAPP Identifying Information		
2.3. Distribution List and Project Personnel Sign-Off Sheet	- Distribution List	Worksheet #3
2.3.1 Distribution List	- Project Personnel Sign-Off Sheet	Worksheet #4
2.3.2 Project Personnel Sign-Off Sheet		
2.4 Project Organization	- Project Organizational Chart	Worksheet #5
2.4.1 Project Organizational Chart	- Communication Pathways	Worksheet #6
2.4.2 Communication Pathways	- Personnel Responsibilities and Qualifications Table	Worksheet #7
2.4.3 Personnel Responsibilities and Qualifications	- Special Personnel Training Requirements Table	Worksheet #8
2.4.4 Special Training Requirements and Certification		
2.5 Project Planning/Problem Definition	- Project Planning Session Documentation (including Data Needs tables)	Worksheet #9
2.5.1 Project Planning (Scoping)	- Project Scoping Session Participants Sheet	Worksheet #10
2.5.2 Problem Definition, Site History, and Background	- Problem Definition, Site History, and Background	
	- Site Maps (historical and present)	
2.6. Project Quality Objectives (PQOs) and Measurement Performance Criteria	- Site-Specific PQOs	Worksheet #11
2.6.1. Development of Project Quality Objectives Using the Systematic Planning Process	- Measurement Performance Criteria Table	Worksheet #12
2.6.2 Measurement Performance Criteria		
2.7 Secondary Data Evaluation	- Sources of Secondary Data and Information	Worksheet #13
	- Secondary Data Criteria and Limitations Table	
2.8 Project Overview and Schedule	- Summary of Project Tasks	Worksheet #14
2.8.1 Project Overview	- Reference Limits and Evaluation Table	Worksheet #15
2.8.2 Project Schedule	- Project Schedule/Timeline Table	Worksheet #16

Measurement/Data Acquisition

3.1 Sampling Tasks	- Sampling Design and Rationale	Worksheet #17
3.1.1 Sampling Process Design and Rationale	- Sample Location Map	Worksheet #18
3.1.2 Sampling Procedures and Requirements	- Sampling Locations and Methods/Standard Operating Procedure (SOP) Requirements Table	Worksheet #19
3.1.2.1 Sampling Collection Procedures	- Analytical Methods/SOP Requirements Table	Worksheet #20
3.1.2.2 Sample Containers, Volume, and Preservation	- Field Quality Control Sample Summary Table	Worksheet #21
3.1.2.3 Equipment/Sample Containers Cleaning and Decontamination Procedures	- Sampling SOPs	Worksheet #22
3.1.2.4 Field Equipment Calibration, Maintenance, Testing, and Inspection Procedures	- Project Sampling SOP References Table	
3.1.2.5 Supply Inspection and Acceptance Procedures	- Field Equipment Calibration, Maintenance, Testing, and Inspection Table	
3.1.2.6 Field Documentation Procedures		
3.2 Analytical Tasks	- Analytical SOPs	Worksheet #23
3.2.1 Analytical SOPs	- Analytical SOP References Table	Worksheet #24
3.2.2 Analytical Instrument Calibration Procedures	- Analytical Instrument Calibration Table	Worksheet #25
3.2.3 Analytical Instrument and Equipment Maintenance, Testing, and Inspection Procedures	- Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table	
3.2.4 Analytical Supply Inspection and Acceptance Procedures		
3.3 Sample Collection Documentation, Handling, Tracking, and Custody Procedures	- Sample Collection Documentation Handling, Tracking, and Custody SOPs	Worksheet #27
3.3.1 Sample Collection Documentation	- Sample Container Identification	
3.3.2 Sample Handling and Tracking System	- Sample Handling Flow Diagram	
3.3.3 Sample Custody	- Example Chain-of-Custody Form and Seal	
3.4 Quality Control Samples	- QC Samples Table	Worksheet #28
3.4.1 Sampling Quality Control Samples	- Screening/Confirmatory Analysis Decision Tree	
3.4.2 Analytical Quality Control Samples		
3.5 Data Management Tasks	- Project Documents and Records Table	Worksheet #29
3.5.1 Project Documentation and Records	- Analytical Services Table	Worksheet #30
3.5.2 Data Package Deliverables	- Data Management SOPs	
3.5.3 Data Reporting Formats		
3.5.4 Data Handling and Management		
3.5.5 Data Tracking and Control		

Assessment/Oversight

4.1 Assessments and Response Actions	- Assessments and Response Actions	Worksheet #31
4.1.1 Planned Assessments		Worksheet #32
Assessment Findings and Corrective Action Responses	- Planned Project Assessments Table	
	- Audit Checklists	
	- Assessment Findings and Corrective Action Responses Table	
4.2 QA Management Reports	- QA Management Reports Table	Worksheet #33
4.3 Final Project Report		

Data Review

5.1 Overview		
5.2 Data Review Steps	- Verification (Step I) Process Table	Worksheet #34
5.2.1 Step I: Verification		Worksheet #35
5.2.2 Step II: Validation	- Validation (Steps IIa and IIb) Process Table	Worksheet #36
5.2.2.1 Step IIa Validation Activities		Worksheet #37
5.2.2.2 Step IIb Validation Activities	- Validation (Steps IIa and IIb) Summary Table	
5.2.3 Step III: Usability Assessment		
5.2.3.1 Data Limitations and Actions from Usability Assessment	- Usability Assessment	
5.2.3.2 Activities		
5.3 Streamlining Data Review		
5.3.1 Data Review Steps To Be Streamlined		
5.3.2 Criteria for Streamlining Data Review		
5.3.3 Amounts and Types of Data Appropriate for Streamlining		

Worksheet #3—Distribution List

(UFP-QAPP Manual Section 2.3.1)

QAPP Recipients	Title	Organization	Telephone Number	Fax Number	E-mail Address	Document Control Number
Kevin Adler	Region 5 Work Assignment Manager	USEPA	312-886-7078	312-353-5541	Adler.Kevin@epa.gov	OMC-OU4-R0-01
TBD	Region 5 Quality Assurance Reveiwer	USEPA				OMC-OU4-R0-02
Ike Johnson	Remedial action contract (RAC) PM	CH2M HILL	414-847-0304	414-272-4408	Ike.Johnson@ch2m.com	OMC-OU4-R0-03
Jewelle Keiser	Site Manager and QA Officer	CH2M HILL	414-847-0469	414-272-4408	Jewelle.Keiser@ch2m.com	OMC-OU4-R0-04
Paul Rohde	Assistant Site Manager	CH2M HILL	414-847-0376	414-272-4408	Paul.Rohde@ch2m.com	OMC-OU4-R0-05
TBD	Field Team Leader & Safety Site Coordinator	CH2M HILL				OMC-OU4-R0-06
Dave Shekoski	Sampling and Analytical Coordinator	CH2M HILL	414-847-0345	414-272-4408	Dave.Shekoski@ch2m.com	OMC-OU4-R0-07
Adrienne Korpela	Project Chemist	CH2M HILL	414-847-0228	414-272-4408	Adrienne.Korpela@ch2m.com	OMC-OU4-R0-08
Cherie Wilson	Project Controls Technician	CH2M HILL	414-847-0219	414-272-4408	Cherie.Wilson@ch2m.com	OMC-OU4-R0-09
TBD	Subcontract Laboratory Manager	TBD				OMC-OU4-R0-10



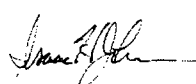
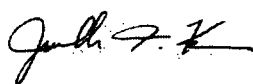

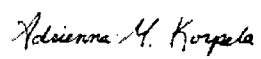
Worksheet #4—Project Personnel Signoff Sheet

(UFP-QAPP Manual Section 2.3.2)

Organization: USEPA

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read
Kevin Adler	Region 5 Work Assignment Manager	312-886-7078		
TBD	Region 5 QA Reviewer			

Organization: CH2M HILL

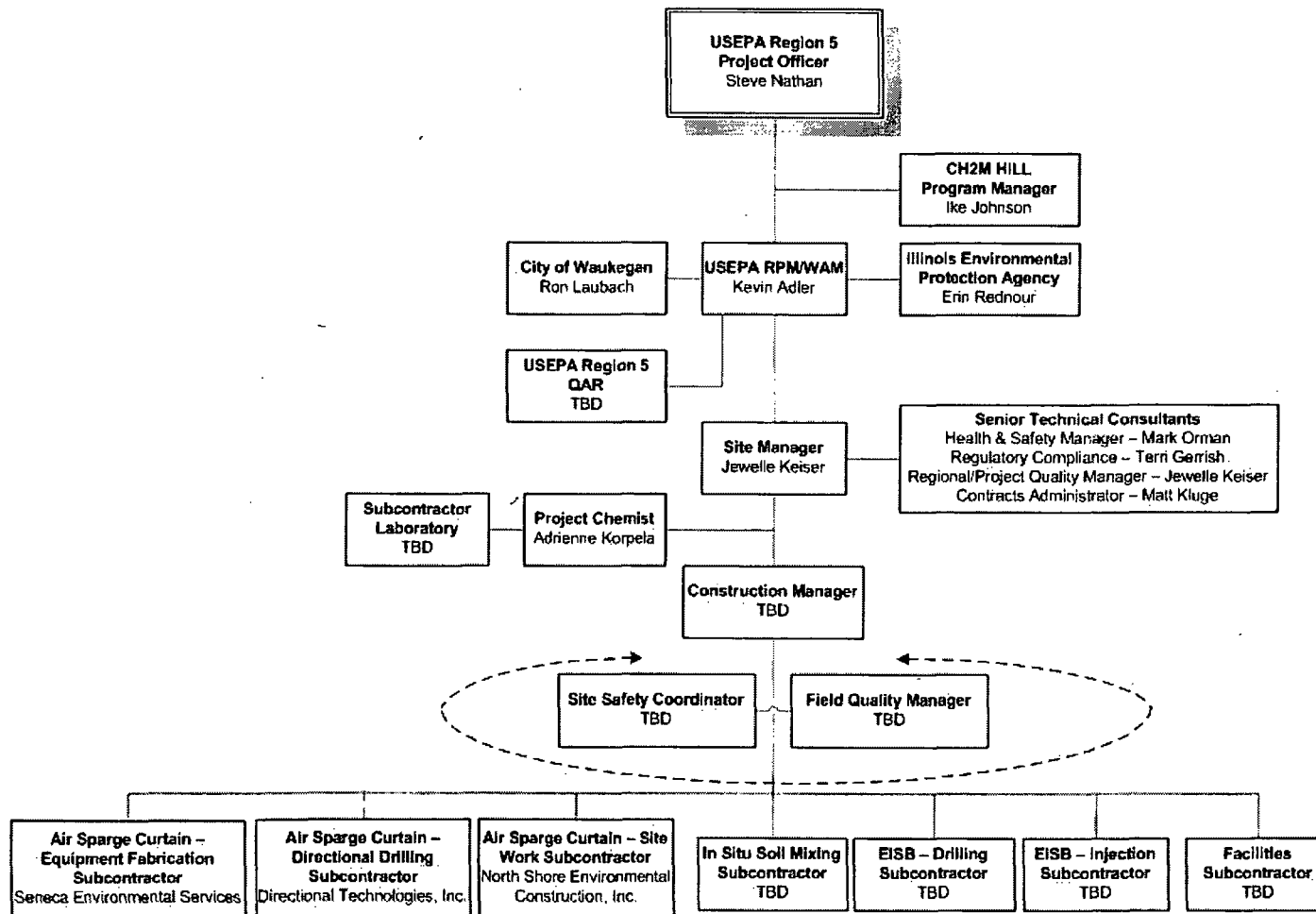
Project Personnel	Title	Telephone Number	Signature	Date QAPP Read
Ike Johnson	RAC PM	414-847-0304		
Jewelle Keiser	Site Manager and QA Officer	414-847-0469		
Paul Rohde	Assistant Site Manager	414-847-0376		
TBD	Field Team Leader & Safety Site Coordinator			
Adrienne Korpela	Project Chemist	414-847-0228		

Organization: Subcontract Laboratory

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read
TBD	Laboratory Manager			
TBD	Project Manager			

Worksheet #5—Project Organizational Chart

(UFP-QAPP Manual Section 2.4.1)





Worksheet #6—Communication Pathways

(UFP-QAPP Manual Section 2.4.2)

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathways, etc.)
Point of contact with USEPA Remedial Program Manager	CH2M HILL Project Manager	Jewelle Keiser	414-847-0469	All materials and information about the project will be forwarded to Kevin Adler by Jewelle Keiser.
Manage all project phases	CH2M HILL Project Manager	Jewelle Keiser	414-847-0469	Notify Kevin Adler of field-related problems by next business day. Serious quality assurance/quality control (QA/QC) issues will be reported to Jewelle Keiser.
Technical communications for project implementation and data interpretation	Assistance Program Manager (APM)	Paul Rohde	414-847-0376	Contact APM regarding questions/issues encountered in the field, input on data interpretation, as needed. APM will have 24 hours to respond to technical field questions as necessary. Responses will be communicated to the Program Manager (PM) by e-mail or phone.
Health and Safety	Site Safety Coordinator (SSC)	TBD		Responsible for the adherence of team members to the site safety requirements described in the Health and Safety Plan. Will report H&S incidents and near losses to PM.
QAPP changes in the field	Field Team Leader	TBD		Notify the PM by phone and e-mail of changes to the SAP made in the field and the reasons within 24 hours. Documentation of deviations from the Work Plan will be kept in the field logbook; deviations made only with the approval of the contractor PM.
Weekly field progress reports	Field Team Leader	TBD		E-mail or fax weekly field progress reports to Jewelle Keiser.
Field corrective actions	Field Team Leader	TBD		The need for corrective action for field issues will be determined by the field team leader. The APM will ensure QAPP requirements are met by field staff. The Field Team Leader will notify the PM of any needed field corrective actions. The PM will have 24 hours to respond to the request for field corrective action.
Reporting lab data quality issues	CLP or subcontracted laboratory	TBD		All QA/QC issues with field samples will be reported to Adrienne Korpela or Dave Shekoski immediately.
Analytical corrective actions	Project Chemist	Adrienne Korpela	414-847-0228	The need for corrective action by the analytical laboratory will be determined by the project chemist. The project chemist will ensure QAPP requirements are met by the laboratory. No analytical data can be released until data usability is completed and approved by the project chemist. The project chemist will review all data as soon as possible upon receipt from the validator.
Release of analytical data	CLP or Subcontracted lab	TBD		No analytical data can be released to CH2M HILL and USEPA until it has been reviewed by the laboratory. No final data can be released to CH2M HILL until validation is completed and the laboratory has approved the release.
QAPP amendments	Region 5 Work Assignment Manager	Kevin Adler	312-886-7078	Any major changes to the QAPP must be approved before the changes can be implemented.

Worksheet #7—Personnel Responsibilities and Qualification Table

(UFP-QAPP Manual Section 2.4.3)

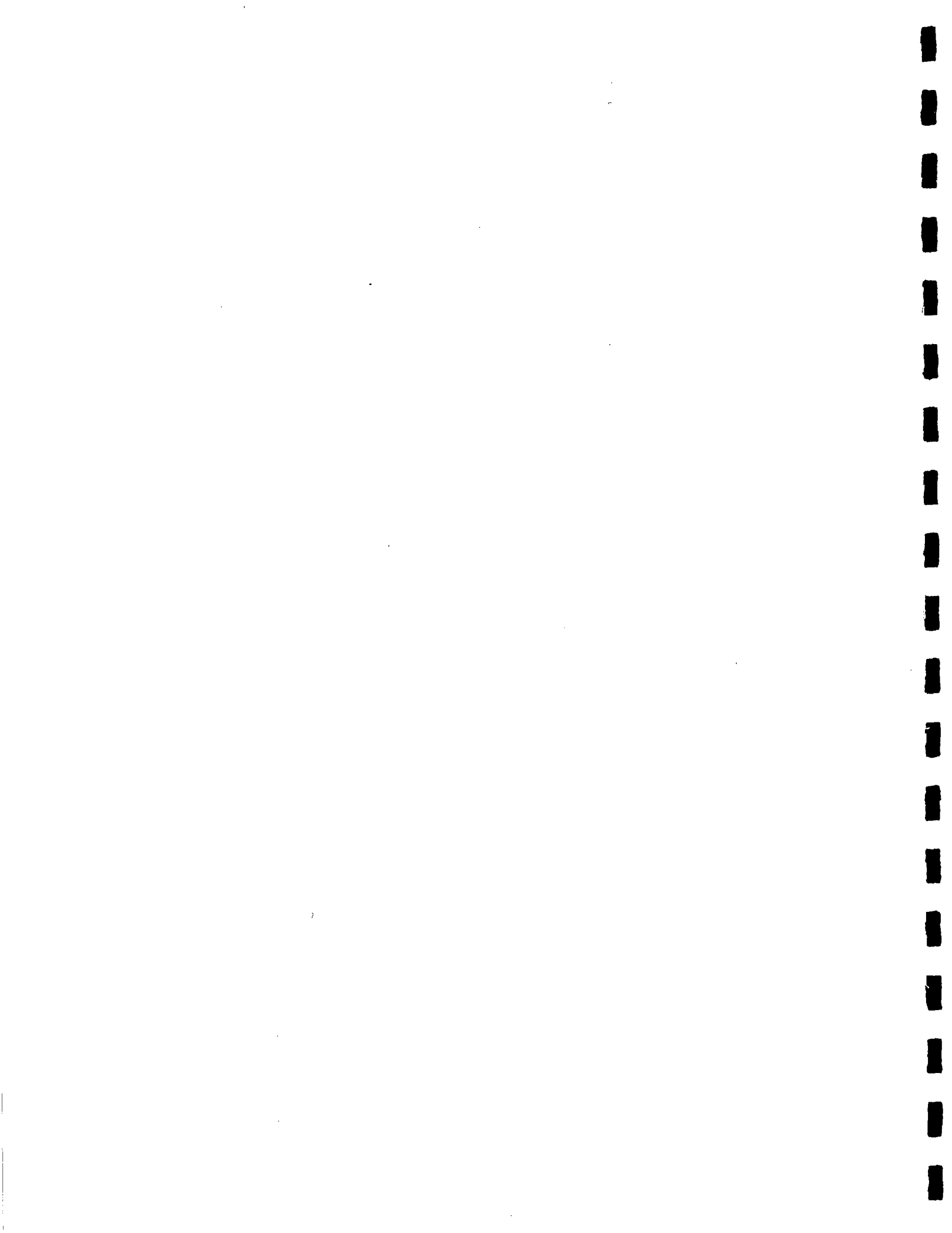
Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Kevin Adler	Region 5 Work Assignment Manager	USEPA	Overall responsibility for all phases of work, review, and approval	
TBD	Region 5 Quality Assurance Reviewer	USEPA	QAPP review and approval	
Ike Johnson	RAC PM	CH2M HILL	Overall responsibility for meeting USEPA objectives and CH2M HILL quality standards, as well as technical QC and project oversight. QAPP review	M.S. and B.S., Geological Engineering, 27 years of experience
Jewelle Keiser	Site Manager and QA Officer	CH2M HILL	Administrative, decision, and approval authority; QA review	M.S., Geology and Geophysics/ Hydrogeology, 23 years of experience
Paul Rohde	Assistant Site Manager	CH2M HILL	Assist the project manager; Design team leader	B.S., Geology and Geophysics, 11 years of experience
Keli McKenna	Environmental Engineer	CH2M HILL	Provides technical design expertise for the remedial design and planning	B.S., Civil Engineering, 12 years of experience
Mark Orman	Health and Safety Operations Manager	CH2M HILL	Conduct health and safety audit	B.S., Environmental Studies, 16 years of experience
TBD	Field Team Leader	CH2M HILL	Coordinate, direct, and participate in site activities; Ensure adherence to the QAPP, report field activities, and communicate issues to the project manager and field team; Contractor oversight	
TBD	SSC	CH2M HILL	Oversee health and safety for all field activities	
Dave Shekoski	Sampling and Analytical Coordinator	CH2M HILL	Coordinate field and laboratory schedules, sample management	A.S., Applied Science, 21 years of experience

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Adrienne Korpela	Project Chemist	CH2M HILL	Assists in QAPP preparation, coordinates laboratory subcontractors, and performs oversight of laboratory and data validation, performs data evaluation	B.S., Biology/Environmental Science, 3 years of experience
TBD	Laboratory PMs		Manages samples tracking and maintains communication with Project Chemist	

Worksheet #8—Special Personnel Training Requirements Table

(UFP-QAPP Manual Section 2.4.4)

Project Function	Specialized Training Title or Description of Course	Training Provider	Training Date	Personnel/Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates
SSC	SSC – Hazardous Waste	Registered training organization	Agency specific	SSC	SSC from CH2M HILL	Contractor, human resources department
Health and Safety	Health and Safety Plan	CH2M HILL	Various	All field personnel and subcontracted project personnel working in the field	All field personnel from CH2M HILL and subcontracted personnel	Sign-off sheet at the end of the Health and Safety Plan



Worksheet #9—Project Scoping Session

Participants Sheet

(UFP-QAPP Manual Section 2.5.1)

Project Name: OMC Plant 2 Site

Site Name: OMC Plant 2 Site

Projected Date(s) of Sampling: TBD

Site Location: Waukegan, IL

Project Manager: Jewelle Keiser

Date of Session: August 5, 2009

Scoping Session Purpose:

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Jewelle Keiser	Site Manager	CH2M HILL	414- 847-0469	Jkeiser1@ch2m.com	Administrative, decision, and approval authority
Paul Rohde	Assistant Site Manager	CH2M HILL	414-847-0376	prohde@ch2m.com	Assist the project manager. Design team leader
Keli McKenna	Design Manager	CH2M HILL	414-847-0561	emckenna@ch2m.com	Assist the project manager. Design team leader
Matt Boekenhauer	Project Engineer	CH2M HILL	414-847-0437	mboekenh@ch2m.com	Soil and sediment design team leader
Carlan Johnson	Staff Engineer	CH2M HILL	414- 847-0239	cjohns19@ch2m.com	Design team member

Comments/Decisions:

- The draft site-specific plans are due to USEPA 30 days after the approval of the prefinal design (September 8, 2009).
- Although the sampling and approach are outlined in the Basis of Design Report, specifics relative to sampling and analytical methods are still subject to change because of USEPA review.
- Work can be initiated on plans, but there are some areas that will need to be revised after reviews are completed. Assignment of personnel and timeline for completion of site plans was accomplished.
- Necessary coordination between the soil and sediment and groundwater remediation basis of design site plans will be completed.

Action Items:

- Finalize site-specific plans based on comments on the final design documents and preliminary plans.

Consensus Decisions: None

Worksheet #10—Problem Definition

(UFP-QAPP Manual Section 2.5.2)

The Problem to be Addressed by the Project

Based on the results of the human health risk assessment, USEPA determined that the trichloroethene (TCE) dense nonaqueous phase liquid (DNAPL) and volatile organic compounds (VOCs) in the groundwater beneath the OMC Plant 2 Site may present unacceptable potential risks to humans under the current and reasonably anticipated future land use exposure scenarios.

Site Description and History

OMC manufactured outboard motors from about 1948 until 2000 in the 1,000,000-square-foot OMC Plant 2 facility. OMC used hydraulic and lubricating oils containing polychlorinated biphenyls (PCBs) in its production-line machinery beginning in 1961 until 1972 and allowed the oils to empty into floor drains that led to either an outfall into former Slip 3 or into the former Crescent Ditch and Oval Lagoon, which fed into the North Ditch. OMC Plant 2 was the source of contamination in Waukegan Harbor (Operable Unit 1) sediment (through the Slip 3 outfall) and likely a source of PCB contamination in Lake Michigan (through the Oval Lagoon, Crescent Ditch, and North Ditch drainage systems). The Oval Lagoon and Crescent Ditch were covered or filled in as a result of the harbor cleanup action conducted from 1990 to 1992 and no longer exist. The West Containment Cell was constructed over the former Oval Lagoon and Crescent Ditch area.

OMC operated several vapor degreasers at the facility to clean newly made parts with TCE. Leaking degreasers and/or TCE storage tanks have created a widespread TCE groundwater contaminant plume and an isolated DNAPL TCE pool beneath the site.

OMC declared bankruptcy in 2000 and ceased manufacturing operations in August 2001. The OMC Plant 2 properties were abandoned and put up for sale by the Trustee during the bankruptcy proceedings. The City of Waukegan assumed the title to the OMC Plant 2 property in December 30, 2005, and is responsible for maintaining the building, property, and operations and maintenance of the containment cells.

Based on the findings of the remedial investigation, in 2008, USEPA completed the pilot test of enhanced in situ bioremediation (EISB) for dissolved groundwater contamination and a bench-scale test of zero-valent iron (ZVI) for remediation of the TCE DNAPL. The findings of the pilot test and bench-scale study are presented in the *Enhanced In Situ Bioremediation Pilot Study Report* (CH2M HILL, 2008a). Based on the results of the pilot test and bench-scale study, the potential alternatives presented in the *Feasibility Study Report* (CH2M HILL, 2006) were re-examined and the *Supplemental Feasibility Study Report* was prepared (CH2M HILL, 2008b). USEPA issued a proposed plan for the cleanup of TCE DNAPL and groundwater in

August 2008 and a Record of Decision in February 2009. Delineation of the PCB DNAPL will take place prior to any treatment alternatives are proposed.

The remedial action for the TCE and PCB DNAPL and contaminated groundwater beneath the OMC Plant 2 consists of the following components:

- Treatment of the downgradient dissolved-phase VOC plume using an air sparge curtain
- Delineation of the TCE DNAPL
- Delineation of the PCB DNAPL
- In situ chemical treatment of the TCE DNAPL by soil mixing with ZVI and bentonite clay
- EISB of the five groundwater source zones by performing periodic injection of a soluble substrate such as sodium lactate
- Monitored natural attenuation (MNA) of groundwater upon completion of active treatment activities

The remedial design for the cleanup of the soil, sediment, and building materials was completed in June 2008 under a separate work assignment. The remedial action for the soil, sediment, and building materials will be initiated under the American Recovery and Reinvestment Act by USEPA's small business RAC contractor. However, prior to the building demolition and soil remedial action, the following activity will be completed: Groundwater sampling of monitoring wells slated for abandonment (within the building footprint, the 20-foot buffer zone around the building, and the in situ soil mixing [ISSM] area).

The following will be completed:

1. Assess air sparge curtain zone of influence and contaminant of concern (COC) concentrations.
2. Ensure iron content design specifications have been met.
3. Verify reduction in soil and groundwater concentrations over time following soil mixing activities.
4. Verify EISB of VOCs is ongoing.
5. Verify MNA of VOCs is ongoing.
6. Characterize solid and aqueous wastes generated during remedial action activities for disposal.
7. Delineation of TCE DNAPL for verifying soil mixing extent.
8. Delineation of PCB DNAPL for future remedial activities.

Observations from any Site Reconnaissance Reports

A site visit was conducted on February 7, 2009, and included the APM and the design lead. The visit was conducted to assist the design lead in developing an understanding of the site

and the logistical considerations (for example, utility locations and Waukegan Coke Plant treatment plant operations) for the remedial action.

A Synopsis of Secondary Data or Information from Site Reports

Groundwater sampling detailed a large contaminant plume beneath the OMC Plant 2 Site that primarily consists of dissolved TCE and its daughter products: vinyl chloride and cis-1,2-dichloroethene (cis-1,2-DCE). The presence of cis-1,2-DCE and vinyl chloride, along with other parameters such as dissolved oxygen levels, indicates that a significant amount of anaerobic biological degradation of the TCE is naturally occurring at the site. Some areas of the plume have groundwater TCE and vinyl chloride levels exceeding 10,000 micrograms per liter ($\mu\text{g/L}$) and cis-1,2-DCE as high as 250,000 $\mu\text{g/L}$. In comparison, target cleanup levels for TCE and vinyl chloride at other Superfund sites approach 1 to 5 $\mu\text{g/L}$ or less. Arsenic was also found to be present in some groundwater samples taken from under the site, although the highest concentrations were found close to or on the adjacent Waukegan Manufactured Gas and Coke Plant Site boundary. Arsenic is a COC at the Waukegan Manufactured Gas and Coke Plant Site.

An estimated 134,000 kilograms of TCE is found as a DNAPL present on the clay surface about 30 feet below ground surface. The DNAPL is a continual source of dissolved TCE contamination to the groundwater beneath the site and it is considered a principle threat waste.

The following are possible classes of contaminants and the affected matrices:

The primary contaminants present in groundwater are VOCs and arsenic. Additionally, the primary contaminant in DNAPL above the till layer is VOCs.

Maximum contaminant concentrations detected in the groundwater during the remedial investigation are presented in Table 1. The specific target compounds for the different sampling activities to be conducted by CH2M HILL are listed on Worksheet #11.

TABLE 1
 Contaminant Concentrations Detected in the Remedial Investigation

Contaminant	Maximum Detected Concentration
VOCs (groundwater)	44 mg/L
Arsenic (groundwater)	0.3570 mg/L
VOCs (DNAPL)	210 mg/L

The Rationale for Inclusion of Chemical and Nonchemical Analyses

The COCs are based on previous site investigations. The selected COCs present the greatest human health concerns and are found at the highest concentrations. Other analytical and field parameters will be collected to monitor performance and assess site conditions.

Information Concerning Various Environmental Indicators

The present environmental site conditions are described in the *Supplemental Feasibility Study Report* (CH2M HILL, 2008b).

Project Decision Conditions (“If..., then...” statements)

If the air sparge curtain does not limit migration of COCs offsite and VOC concentrations south of the curtain are not below cleanup criteria, then alternative remedial technologies in the feasibility study will be re-evaluated.

If iron content design specifications are not met, then additional iron will be added to the mix until design specifications are met.

If soil and groundwater concentrations are not reduced following soil mixing activities, then other remedies will be implemented.

If EISB conditions are not present, then additional substrate will be added until conditions indicating EISB are achieved.

Worksheet #11—Project Quality Objectives/Systematic Planning Process Statements

(UFP-QAPP Manual Section 2.6.1)

Who Will Use the Data?

The data will be used by CH2M HILL and USEPA.

What Will the Data be Used For?

Predemolition Activities

Groundwater samples collected prior to building demolition from monitoring wells slated for abandonment (within building footprint, the 20-foot buffer zone around the building and the ISSM area) to obtain a final round of analytical data for this set of wells prior to demolition. The data will be used to determine current groundwater conditions and to evaluate any ongoing trends.

Air Sparge

- Groundwater samples collected from well pairs in the vicinity of the air sparge well during sparge system startup and performance monitoring to assess air sparge curtain zone of influence and COC concentrations.
- Soil samples from drill cuttings and other soil waste generated by air sparge well drilling and installation activities. The actual waste profiles for acceptance of contaminated soil by an offsite disposal facility will be completed by CH2M HILL on behalf of USEPA.

In Situ Soil Mixing

- Soil samples collected from the ISSM mixed areas during and immediately after ISSM activities to verify iron content design specification has been met and establish baseline conditions.
- Soil samples collected from the ISSM mixed area at 1, 6, and 12 months following mixing to verify reduction percentages in comparison to baseline conditions.
- Groundwater samples collected from ISSM temporary performance wells located within the mixed area to monitor changes in the groundwater concentrations over time following soil mixing activities.

Enhanced In Situ Bioremediation

Groundwater samples collected from EISB monitoring wells associated with five source zones to establish baseline conditions, evaluate EISB progress, determine injection frequency, and verify EISB is ongoing.

Monitored Natural Attenuation

Groundwater samples collected annually from sitewide monitoring wells to evaluate MNA sitewide.

All Phases

Wastewater samples collected from aqueous waste containerized during all construction phases and subsequent groundwater monitoring activities. To be collected prior to disposal.

What Types of Data are Needed? (target analytes, analytical groups, field screening, onsite analytical or offsite laboratory techniques, sampling techniques)

Remedial Action Task	Sampling Activity/Objective	Sampling Frequency/Duration	Matrix	Parameters
Predemolition				
Predemolition Groundwater Monitoring	Collect samples from monitoring wells slated for abandonment (within building footprint, the 20-foot buffer zone around the building and the ISSM area)	One time, prior to building demolition	Groundwater	VOCs, Dissolved gases, Dissolved Metals, MNA Parameters ^a , and PCBs (at four locations) Field Measurements ^b
IDW Characterization	Collect sample to characterize aqueous waste generated during the monitoring event	One time prior to disposal	Water	VOCs, Dissolved Arsenic, PCBs
Downgradient Air Sparge Construction Phase				
System Startup and Performance Monitoring	Collect samples from monitoring wells hydraulically upgradient and downgradient of air sparge curtain Assess air sparge curtain zone of influence and COC concentrations	Week 1: Daily water level gauging Month 1: Weekly Field Measurements Quarterly: Field Measurements and groundwater samples to be analyzed for VOCs and arsenic	Groundwater	VOCs, Dissolved Arsenic Field Measurements: Water Level, Oxidation Reduction Potential, Dissolved Oxygen, Wellhead Pressures

Remedial Action Task	Sampling Activity/Objective	Sampling Frequency/Duration	Matrix	Parameters
IDW Characterization	Collect sample to characterize solid waste generated during the drilling and installation of the air sparge well	Prior to disposal	Soil	Per requirements of disposal facility; May include the following: TCLP: VOCs, SVOCs, RCRA Metals; Reactive Cyanide, Reactive Sulfide, pH, Specific Gravity, Total Solids, Free Liquids, Flash Point, VOCs, SVOCs, PCBs
IDW Characterization	Collect sample to characterize aqueous waste generated during the drilling, construction, and development of the air sparge well	Prior to disposal	Water	VOCs, Dissolved Arsenic, PCBs
ISSM Construction Phase				
PCB and TCE DNAPL Delineation	Visually inspect boreholes for the presence of product or sheen to delineate the extent of DNAPL in two locations Collect groundwater grab samples from each borehole and inspect for presence or product	One time, prior to ISSM activities	Soil	Visual inspection for product.
QA/QC and Baseline Sampling	Field analysis of iron content in soil samples from the mixed areas during and immediately after mixing to ensure iron content design specification has been met	Week 1: Three samples will be collected from the first soil core of each day (top, midpoint, and 1 foot above the bottom); Two samples will be collected from a second soil core each day (midpoint and 1 foot above the bottom). Week 2 Completion: Two samples will be collected from one core each day (midpoint and 1 foot above the bottom)	Soil	Iron Content
		Soil cores will be collected at a frequency of one core per 1,000 cubic yards.	Soil	VOCs

Remedial Action Task	Sampling Activity/Objective	Sampling Frequency/Duration	Matrix	Parameters
Post-Mixing Performance Sampling	Monitor changes in the soil concentrations over time following soil mixing activities and verify reduction percentages in comparison to baseline conditions	At 1, 6, and 12 months following mixing: Two samples will be collected per soil core: at the midpoint, and 1 foot above the bottom	Soil	VOCs
Temporary Performance Well Sampling	Monitor changes in the groundwater concentrations over time following soil mixing activities	At 0, 1, 6, and 12 months following mixing: 2 wells sampled	Groundwater	VOCs, Dissolved Gases, Dissolved Metals, MNA Parameters, and Field Measurements only if sample volume allows
IDW Characterization	Collect sample to characterize decontamination water, storm water, and other aqueous waste containerized during ISSM construction	Prior to disposal	Water	VOCs, Dissolved Arsenic, PCBs
EISB Construction Phase				
EISB Baseline Monitoring	Samples will be collected from select source zone monitoring wells to establish conditions to evaluate the progression of the effects of the EISB injections	One time, less than 90 days prior to first injection	Groundwater	VOCs, volatile fatty acids (VFAs), TOC, Dissolved Gases, Dissolved Metals, MNA Parameters Field Measurements
EISB Performance Monitoring	Samples will be collected from select source zone monitoring wells to determine injection frequency and to verify EISB effectiveness	Quarterly for 4 years	Groundwater	VOCs, VFAs, TOC Field Measurements
IDW Characterization	Collect sample to characterize aqueous waste containerized during EISB construction activities	Prior to disposal	Water	VOCs, Dissolved Arsenic, PCBs

Remedial Action Task	Sampling Activity/Objective	Sampling Frequency/Duration	Matrix	Parameters
MNA Phase				
MNA Sitewide Groundwater Sampling	Provide analytical data to evaluate MNA sitewide	Yearly for an estimated 30 years	Groundwater	VOCs, Dissolved Gases, Dissolved Metals, MNA Parameters, and PCBs (at 4 monitoring wells: MW-530S, MW-530D, MW-619S, and MW-619D) Field Measurements
IDW Characterization	Collect sample to characterize aqueous waste generated during groundwater monitoring events for all four remedial action phases	Prior to disposal	Water	VOCs, Dissolved Arsenic, PCBs

Notes: VOCs = Volatile Organic Compounds, TCLP = Toxicity Characteristic Leaching Procedure, VFAs = Volatile Fatty Acids, PCBs = Polychlorinated Biphenyls, SVOCs = Semivolatile Organic Compounds, TOC = Total Organic Carbon, CY = Cubic yards

^a MNA parameters include the following: Alkalinity, Nitrate/Nitrite, Chloride, Sulfate, Sulfide

^b Field Measurements include the following: Water Level, Turbidity, Temperature, Specific Conductance, Oxidation Reduction Potential, Dissolved Oxygen, pH

How "Good" Do the Data Need to be in Order to Support the Environmental Decision?

The data should meet the project action levels from the Record of Decision, as specified in QAPP Worksheet #15 and the QC requirements that are explained in QAPP Worksheet #37.

How Much Data are Needed? (number of samples for each analytical group, matrix, and concentration)

See Worksheet #20.

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Where, when, and how should the data be collected/generated?

Detailed information on where, when, and how the data will be collected is provided in Worksheet #14.

Who will collect and generate the data?

CH2M HILL will collect the data, and the CLP and independent subcontracted laboratory will generate the data.

Contract Laboratory Program Analysis

Analytical laboratories in USEPA's CLP will be used to the extent possible. The use of the CLP is dependent on the media to be analyzed, specific analyses, and required turnaround times. The ability of the CLP to meet specific media objectives for this remedial action will be discussed in the QAPP.

Independent Laboratory Analysis

It is anticipated that most of the samples will be submitted to the CLP, and in addition, some will need to be analyzed by an independent laboratory procured by CH2M HILL. These special analytical services will include analysis for MNA parameters (alkalinity, nitrate/nitrite, chloride, sulfate, and sulfide) and dissolved gases, EISB performance monitoring parameters TOC and VFAs, as well as solid waste characterization samples.

How will the data be reported?

Full CLP reporting is required for all non-field analytical data for CLP. Level 3 data packages are required for all subcontracted non-field analytical data.

How will the data be archived?

See Attachment 1, Data Management Plan.

Worksheet #12-1—Measurement Performance Criteria Table

(UFP-QAPP Manual Section 2.6.2)

Matrix Groundwater

Analytical Group TCL Volatiles

Concentration Level Low

Sampling Procedure ^a	Analytical Method/SOP ^b	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S & A)
Field operating procedure (FOP) #1	LAB SOP #1	Precision	RPD +/- 30%	MS/MSD, FD	A
		Accuracy/Bias	+/- Percent Recovery	LCS, MS	A
		Completeness	> 90% Laboratory Analysis	Percent Completeness	S & A
		Representativeness	Contamination of sample or extract with a COC	MB, EB	S & A
		Comparability	Qualitative measure for field sampling procedures	LCS, MS	A

^aReference number from QAPP Worksheet #21 (see Section 3.1.2)

^bReference number from QAPP Worksheet #23 (see Section 3.2)

LCS = laboratory control sample, EB = equipment blank, MS = matrix spike, MSD = matrix spike duplicate

Worksheet #12-2—Measurement Performance Criteria Table

(UFP-QAPP Manual Section 2.6.2)

Matrix Soil

Analytical Group TCL Volatiles

Concentration Level Low

Sampling Procedure ^a	Analytical Method/SOP ^b	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S & A)
FOP #5 and #6	LAB SOP #1	Precision	RPD \pm 30%	MS/MSD, FD	A
		Accuracy/Bias	\pm Percent Recovery	LCS, MS	A
		Completeness	> 90% Laboratory Analysis	Percent Completeness	S & A
		Representativeness	Contamination of sample or extract with a COC	MB, EB	S & A
		Comparability	Qualitative measure for field sampling procedures	LCS, MS	A

^aReference number from QAPP Worksheet #21 (see Section 3.1.2)

^bReference number from QAPP Worksheet #23 (see Section 3.2)

LCS = laboratory control sample, EB = equipment blank, MS = matrix spike, MSD = matrix spike duplicate

Worksheet #12-3—Measurement Performance Criteria Table

(UFP-QAPP Manual Section 2.6.2)

Matrix Groundwater
Analytical Group Dissolved Gases
Concentration Level Low

Sampling Procedure ^a	Analytical Method/SOP ^b	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S & A)
FOP #1	LAB SOP #2	Precision	RPD \pm 30%	MS/MSD, FD, LD	A
		Completeness	> 90% Laboratory Analysis	Percent Completeness	S & A
		Representativeness	Contamination of sample or extract with a COC	MB, EB	S & A

^aReference number from QAPP Worksheet #21 (see Section 3.1.2)

^bReference number from QAPP Worksheet #23 (see Section 3.2)

EB = equipment blank, MS = matrix spike, MSD = matrix spike duplicate

Worksheet #12-4—Measurement Performance Criteria Table

(UFP-QAPP Manual Section 2.6.2)

Matrix Groundwater

Analytical Group Dissolved Metals

Concentration Level Low

Sampling Procedure ^a	Analytical Method/SOP ^b	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S & A)
FOP #1	LAB SOP #3	Precision	RPD \pm 30%	MS/MSD, FD, LD	S & A
		Accuracy/Bias	\pm Percent Recovery	LCS, MS	A
		Completeness	> 90% Laboratory Analysis	Percent Completeness	S & A
		Representativeness	Contamination of sample or extract with a COC	MB, PB, EB	S & A
		Comparability	Qualitative measure for field sampling procedures	LCS, MS	A
		Sensitivity	Evidence of shift in instrument response or zero setting	LCS	A

^aReference number from QAPP Worksheet #21 (see Section 3.1.2)

^bReference number from QAPP Worksheet #23 (see Section 3.2)

LCS = laboratory control sample, EB = equipment blank, MS = matrix spike, MSD = matrix spike duplicate

Worksheet #12-5—Measurement Performance Criteria Table

(UFP-QAPP Manual Section 2.6.2)

Matrix Groundwater
Analytical Group MNA, TOC, and VFA
Concentration Level Low

Sampling Procedure ^a	Analytical Method/SOP ^b	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S & A)
FOP #1	LAB SOP #4-10	Precision	RPD \pm 30%	MS/MSD, FD, LD	S & A
		Accuracy/Bias	\pm Percent Recovery	LCS, MS	A
		Completeness	90% Laboratory Analysis 100% of field samples collected	Percent Completeness	S & A
		Representativeness	Contamination of sample or extract with a COC	MB, PB, EB	S & A
		Comparability	Qualitative measure for field sampling procedures	LCS, MS	A
		Sensitivity	Evidence of shift in instrument response or zero setting MDLs	LCS	A

^aReference number from QAPP Worksheet #21 (see Section 3.1.2)

^bReference number from QAPP Worksheet #23 (see Section 3.2)

LCS = laboratory control sample, EB = equipment blank, MS = matrix spike, MSD = matrix spike duplicate, MDL = method detection limit

Worksheet #12-6—Measurement Performance Criteria Table

(UFP-QAPP Manual Section 2.6.2)

Matrix Groundwater

Analytical Group PCBs

Concentration Level Low

Sampling Procedure ^a	Analytical Method/SOP ^b	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)
FOP #1	LAB SOP #11	Precision	RPD \pm 30%	MS/MSD, FD, LD	A
		Accuracy/Bias	\pm Percent Recovery	LCS, MS	A
		Completeness	> 90% Laboratory Analysis, 100% field sample collection	Percent Completeness	S & A
		Representativeness	Contamination of sample or extract with a contaminant of concern	MB, EB	S & A
		Comparability	Qualitative measure for field sampling procedures	LCS, MS	A
		Sensitivity	Evidence of shift in instrument response or zero setting Method Detection Limits	LCS	A

^aReference number from QAPP Worksheet #21 (see Section 3.1.2)

^bReference number from QAPP Worksheet #23 (see Section 3.2)

LCS = laboratory control sample, EB = equipment blank, MS = matrix spike, MSD = matrix spike duplicate

Worksheet #13—Secondary Data Criteria and Limitations Table

(UFP-QAPP Manual Section 2.7)

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s)		
		(Originating Org., Data Types, Data Generation/ Collection Dates)	How Data Will Be Used	Limitations on Data Use
DNAPL and VOC contamination data	CH2M HILL, <i>Remedial Investigation Report</i> , April 2006	CH2M HILL	To assess the potential sources of contaminated soil and groundwater contamination	It is possible that additional contaminated areas exist outside those identified or that concentrations vary from those in the Data Source.
DNAPL and VOC contamination data	CH2M HILL, <i>Enhanced In Situ Bioremediation Pilot Study Report</i> , 2008	CH2M HILL	To determine whether in situ technologies could be used as a major component of the groundwater remedy and how the selected in situ technology would be implemented full scale	None known.
ISSM	Colorado State University, <i>Bench Scale Evaluation of ZVI-clay</i> , June 2006 Attachment to the <i>Supplemental Feasibility Study Report</i> (CH2M HILL, June 2006)	CH2M HILL and Colorado State University	To determine the optimal iron concentration for soil mixing	None known.



Worksheet #14—Summary of Project Tasks

(UFP-QAPP Manual Section 2.8.1)

Sampling Tasks

Applicable SOPs for project tasks outlined in the section are listed on Worksheet #21 and attached. The sampling tasks are described on Worksheets #17 and 18.

Analysis Tasks

The CLP or subcontract laboratory will analyze soil and groundwater samples for VOCs, dissolved metals, and PCBs.

The subcontract laboratory will analyze groundwater samples for quick-turn VOCs, dissolved gases, MNA parameters, TOC, and VFAs. The subcontract laboratory will also analyze solid and aqueous samples for waste characterization parameters.

Specific methods for each analysis are found on Worksheet #23.

Quality Control Tasks

Implement FOPs. QC samples are described on Worksheet #28.

Secondary Data

See QAPP Worksheet #13.

Data Management Tasks

Data management tasks are described in the attached Data Management Plan.

Documentation and Records

1. Records and field measurements of all samples will be collected in notebooks. chains of custody, airbills, and sample logs will be prepared and retained for each sample.
2. A copy of the final QAPP will be kept at the CH2M HILL Milwaukee office.

Assessment/Audit Tasks

1. Health and Safety Audit
2. Field Audit

Data Review Tasks

1. The laboratory will make sure the data are complete for all samples received. The CLP data will be validated by USEPA using the USEPA National Functional Guidelines, and the subcontract laboratory data will be validated by CH2M HILL using the USEPA National Functional Guidelines, laboratory SOPs, and the QAPP.
2. Validated data and field logs will be reviewed to assess total measurement error and determine overall usability of the data for project purposes. Final data are placed in the database with qualifiers.

Worksheet #15-1—Reference Limits and Evaluation Table

(UFP-QAPP Manual Section 2.8.1)

Matrix: Groundwater

Analytical Group: TCL Volatiles

Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/L)	Project Quantitation Limit (µg/L)	Analytical Method		Achievable Laboratory Limits	
				MDLs	Method QLs	MDLs	QLs
Dichlorodifluoromethane	75-71-8	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
Chloromethane	74-87-3	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
Bromomethane	74-83-9	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
Vinyl Chloride	75-01-4	2 µg/L	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
Chloroethane	75-00-3	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
Trichlorofluoromethane	75-69-4	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
Methylene Chloride	75-09-2	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
Acetone	67-64-1	N/A	5.0	TBD*	5.0 µg/L	TBD*	5.0 µg/L
Carbon Disulfide	75-15-0	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
Methyl Acetate	79-20-9	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
1,1-Dichloroethene	75-35-4	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
1,1-Dichloroethane	75-34-3	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
cis-1,2-Dichloroethene	156-59-2	70 µg/L	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
trans-1,2-Dichloroethene	156-60-5	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L

Matrix: Groundwater

Analytical Group: TCL Volatiles

Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/L)	Project Quantitation Limit (µg/L)	Analytical Method		Achievable Laboratory Limits	
				MDLs	Method QLs	MDLs	QLs
Methyl tert-Butyl Ether	1634-04-4	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
Chloroform	67-66-3	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
1,2-Dichloroethane	107-06-2	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
2-Butanone	78-93-3	N/A	5.0	TBD*	5.0 µg/L	TBD*	5.0 µg/L
Bromochloromethane	74-97-5	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
1,1,1-Trichloroethane	71-55-6	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
Cyclohexane	110-82-7	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
Carbon Tetrachloride	56-23-5	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
Bromodichloromethane	75-27-4	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
1,2-Dichloropropane	78-87-5	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
cis-1,3-Dichloropropene	10061-01-5	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
Trichloroethene	79-01-6	5 µg/L	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
Methylcyclohexane	108-87-2	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
Dibromochloromethane	124-48-1	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
1,1,2-Trichloroethane	79-00-5	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
Benzene	71-43-2	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
trans-1,3-Dichloropropene	10061-02-6	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
Bromoform	75-25-2	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
Isopropylbenzene	98-82-8	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
4-Methyl-2-pentanone	108-10-1	N/A	5.0	TBD*	5.0 µg/L	TBD*	5.0 µg/L

Matrix: Groundwater

Analytical Group: TCL Volatiles

Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/L)	Project Quantitation Limit (µg/L)	Analytical Method		Achievable Laboratory Limits	
				MDLs	Method QLs	MDLs	QLs
2-Hexanone	591-78-6	N/A	5.0	TBD*	5.0 µg/L	TBD*	5.0 µg/L
Tetrachloroethene	127-18-4	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
1,2-Dibromoethane	106-93-4	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
Toluene	108-88-3	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
1,1,2,2-Tetrachloroethane	79-34-5	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
Chlorobenzene	108-90-7	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
Ethylbenzene	100-41-4	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
Styrene	100-42-5	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
Xylenes (Total)	1330-20-7	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
1,2-Dibromo-3-chloropropane	96-12-8	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
1,3-Dichlorobenzene	541-73-1	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
1,4-Dichlorobenzene	106-46-7	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
1,2-Dichlorobenzene	95-50-1	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
1,2,3-Trichlorobenzene	87-61-6	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L
1,2,4-Trichlorobenzene	120-82-1	N/A	0.50	TBD*	0.50 µg/L	TBD*	0.50 µg/L

* As required by CLP SOW SOM01.2 or by subcontracted laboratory
 MDL = method detection limit

Worksheet #15-2—Reference Limits and Evaluation Table

(UFP-QAPP Manual Section 2.8.1)

Matrix: Soil

Analytical Group: TCL Volatiles

Concentration Level: Low

Analyte	CAS Number	Project Action Limit	Project Quantitation Limit (µg/kg)	Analytical Method		Achievable Laboratory Limits	
				MDLs	Method QLs	MDLs	QLs
Dichlorodifluoromethane	75-71-8	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
Chloromethane	74-87-3	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
Bromomethane	74-83-9	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
Vinyl Chloride	75-01-4	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
Chloroethane	75-00-3	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
Trichlorofluoromethane	75-69-4	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
Methylene Chloride	75-09-2	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
Acetone	67-64-1	N/A	10	TBD*	10 µg/kg	TBD*	10 µg/kg
Carbon Disulfide	75-15-0	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
Methyl Acetate	79-20-9	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
1,1-Dichloroethene	75-35-4	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
1,1-Dichloroethane	75-34-3	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
cis-1,2-Dichloroethene	156-59-2	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg

Matrix: Soil

Analytical Group: TCL Volatiles

Concentration Level: Low

Analyte	CAS Number	Project Action Limit	Project Quantitation Limit (µg/kg)	Analytical Method		Achievable Laboratory Limits	
				MDLs	Method QLs	MDLs	QLs
trans-1,2-Dichloroethene	156-60-5	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
Methyl tert-Butyl Ether	1634-04-4	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
Chloroform	67-66-3	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
1,2-Dichloroethane	107-06-2	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
2-Butanone	78-93-3	N/A	10	TBD*	10 µg/kg	TBD*	10 µg/kg
Bromochloromethane	74-97-5	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
1,1,1-Trichloroethane	71-55-6	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
Cyclohexane	110-82-7	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
Carbon Tetrachloride	56-23-5	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
Bromodichloromethane	75-27-4	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
1,2-Dichloropropane	78-87-5	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
cis-1,3-Dichloropropene	10061-01-5	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
Trichloroethene	79-01-6	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
Methylcyclohexane	108-87-2	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
Dibromochloromethane	124-48-1	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
1,1,2-Trichloroethane	79-00-5	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
Benzene	71-43-2	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
trans-1,3-Dichloropropene	10061-02-6	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
Bromoform	75-25-2	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg

Matrix: Soil

Analytical Group: TCL Volatiles

Concentration Level: Low

Analyte	CAS Number	Project Action Limit	Project Quantitation Limit (µg/kg)	Analytical Method		Achievable Laboratory Limits	
				MDLs	Method QLs	MDLs	QLs
Isopropylbenzene	98-82-8	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
4-Methyl-2-pentanone	108-10-1	N/A	10	TBD*	10 µg/kg	TBD*	10 µg/kg
2-Hexanone	591-78-6	N/A	10	TBD*	10 µg/kg	TBD*	10 µg/kg
Tetrachloroethene	127-18-4	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
1,2-Dibromoethane	106-93-4	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
Toluene	108-88-3	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
1,1,2,2-Tetrachloroethane	79-34-5	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
Chlorobenzene	108-90-7	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
Ethylbenzene	100-41-4	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
Styrene	100-42-5	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
Xylenes (Total)	1330-20-7	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
1,2-Dibromo-3-chloropropane	96-12-8	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
1,3-Dichlorobenzene	541-73-1	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
1,4-Dichlorobenzene	106-46-7	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
1,2-Dichlorobenzene	95-50-1	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
1,2,3-Trichlorobenzene	87-61-6	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg
1,2,4-Trichlorobenzene	120-82-1	N/A	5.0	TBD*	5.0 µg/kg	TBD*	5.0 µg/kg

* As required by CLP SOW SOM01.2 or by subcontracted laboratory
 MDL = method detection limit

Worksheet #15-3—Reference Limits and Evaluation Table

(UFP-QAPP Manual Section 2.8.1)

Matrix: Groundwater

Analytical Group: Dissolved Gases

Concentration Level: Low

Analyte	CAS Number	Project Action Limit (applicable units)	Project Quantitation Limit (µg/L)	Analytical Method		Achievable Laboratory Limits	
				MDLs	Method QLs	MDLs	QLs
Methane	74-82-8	N/A	10.0	0.5 µg/L	10 µg/L	TBD*	TBD*
Ethane	74-84-0	N/A	10.0	0.5 µg/L	10 µg/L	TBD*	TBD*
Ethene	74-85-1	N/A	10.0	0.5 µg/L	10 µg/L	TBD*	TBD*

* Varies by laboratory

MDL = method detection limit

Worksheet #15-4—Reference Limits and Evaluation Table

(UFP-QAPP Manual Section 2.8.1)

Matrix: Groundwater

Analytical Group: Dissolved Metals

Concentration Level: Low

Analyte	CAS Number	Project Action Limit (µg/L)	Project Quantitation Limit (µg/L)	Analytical Method		Achievable Laboratory Limits	
				MDLs	Method QLs	MDLs	QLs
Arsenic	7440-38-2	10 µg/L	1	TBD*	1 µg/L	TBD*	1 µg/L
Iron	7439-89-6	N/A	100	TBD*	100 µg/L	TBD*	100 µg/L
Manganese	7439-96-5	N/A	15	TBD*	15 µg/L	TBD*	15 µg/L

* As required by CLP SOW ILM05.4 or by subcontracted laboratory
 MDL = method detection limit

Worksheet #15-5—Reference Limits and Evaluation Table

(UFP-QAPP Manual Section 2.8.1)

Matrix: Groundwater

Analytical Group: MNA Parameters and Total Organic Carbon (TOC)

Concentration Level: Low

Analyte	CAS Number	Project Action Limit (applicable units)	Project Quantitation Limit (mg/L)	Analytical Method		Achievable Laboratory Limits	
				MDLs	Method QLs	MDLs	QLs
Alkalinity	N/A	N/A	5	TBD*	5 mg/L	TBD*	5 mg/L
Chloride	16887-00-6	N/A	0.5	TBD*	0.5 mg/L	TBD*	0.5 mg/L
Nitrate	14797-55-8	N/A	0.5	TBD*	0.5 mg/L	TBD*	0.5 mg/L
Nitrite	14979-65-0	N/A		TBD*		TBD*	
Sulfate	14808-79-8	N/A	0.5	TBD*	0.5 mg/L	TBD*	0.5 mg/L
Sulfide	N/A	N/A	2	TBD*	2 mg/L	TBD*	2 mg/L
Total Organic Carbon	N/A	N/A	0.5	TBD*	0.5 mg/L	TBD*	0.5 mg/L

* Varies by laboratory

MDL = method detection limit

Worksheet #15-6—Reference Limits and Evaluation Table

(UFP-QAPP Manual Section 2.8.1)

Matrix: Groundwater

Analytical Group: Volatile Fatty Acids

Concentration Level: Low

Analyte	CAS Number	Project Action Limit (applicable units)	Project Quantitation Limit (applicable units)	Analytical Method		Achievable Laboratory Limits	
				MDLs	Method QLs	MDLs	QLs
Acetic Acid	64-19-7	N/A		TBD*		TBD*	
Butanoic Acid	107-92-6	N/A		TBD*		TBD*	
Formic Acid	64-18-6	N/A		TBD*		TBD*	
Lactic Acid	50-21-5	N/A		TBD*		TBD*	
Propionic Acid	79-09-4	N/A		TBD*		TBD*	
Pyruvic Acid	127-17-3	N/A		TBD*		TBD*	

* Varies by laboratory
 MDL = method detection limit

Worksheet #15-7—Reference Limits and Evaluation Table

(UFP-QAPP Manual Section 2.8.1)

Matrix: Groundwater

Analytical Group: PCBs

Concentration Level: Low

Analyte	CAS Number	Project Action Limit (applicable units)	Project Quantitation Limit (µg/L)	Analytical Method		Achievable Laboratory Limits	
				MDLs	Method QLs	MDLs	QLs
Aroclor-1016	12674-11-2	N/A	1.0	TBD*	1.0 µg/L	TBD*	1.0 µg/L
Aroclor-1221	11104-28-2	N/A	1.0	TBD*	1.0 µg/L	TBD*	1.0 µg/L
Aroclor-1232	11141-16-5	N/A	1.0	TBD*	1.0 µg/L	TBD*	1.0 µg/L
Aroclor-1242	53469-21-9	N/A	1.0	TBD*	1.0 µg/L	TBD*	1.0 µg/L
Aroclor-1248	12672-29-6	N/A	1.0	TBD*	1.0 µg/L	TBD*	1.0 µg/L
Aroclor-1254	11097-69-1	N/A	1.0	TBD*	1.0 µg/L	TBD*	1.0 µg/L
Aroclor-1260	11096-82-5	N/A	1.0	TBD*	1.0 µg/L	TBD*	1.0 µg/L
Aroclor-1262	37324-23-5	N/A	1.0	TBD*	1.0 µg/L	TBD*	1.0 µg/L
Aroclor-1268	11100-14-4	N/A	1.0	TBD*	1.0 µg/L	TBD*	1.0 µg/L

* As required by CLP SOW SOM01.2 or by subcontracted laboratory
 MDL = method detection limit



Worksheet #16—Project Schedule Timeline Table

(UFP-QAPP Manual Section 2.8.2)

Activities	Organization	Dates		Deliverable	Deliverable Due Date
		Anticipated Date(s) of Initiation	Anticipated Date of Completion		
Site Specific Plans	CH2M HILL	May 2009	January 2010	Site Specific Plans	January 2010
Sample Collection	CH2M HILL	TBD	TBD	Samples to Lab	N/A
Laboratory Analysis	CLP Lab	Within required analytical holding times	21 days after sample receipt	Data Package	21 days after sample receipt
Laboratory Analysis	Contract Laboratory	Within required analytical holding times	21 days after sample receipt	Data Package	21 days after sample receipt
Data Validation	USEPA or CH2M HILL	After receipt of analytical data reports	1 to 3 months after receipt of final data	Data Validation Report	N/A
Data Review	CH2M HILL	After receipt of final data	30 days after receipt of final data	Date Review Report	30 days after receipt of final data reports
Final Project Report	CH2M HILL	After project initiation	Project phase completion	Final Project Report	60 days after project completion for each project phase



Worksheet #17—Sampling Design and Rationale

(UFP-QAPP Manual Section 3.1.1)

Describe and provide a rationale for choosing the sampling approach (e.g., grid system, biased statistical approach). Describe the sampling design and rationale in terms of what matrices will be sampled, what analytical groups will be analyzed and at what concentration levels, the sampling locations (including QC, critical, and background samples), the number of samples to be taken, and the sampling frequency (including seasonal considerations) [May refer to map or Worksheet #18 for details.]

Predemolition Groundwater Monitoring

The remedial action for the soil, sediment, and building materials will be initiated under the American Recovery and Reinvestment Act by USEPA's small business RAC contractor. However, prior to the building demolition and soil remedial action, the following activity will be completed:

Groundwater sampling of monitoring wells slated for abandonment (within the building footprint, the 20-foot buffer zone around the building, and the ISSM area, see Figure 1).

Monitoring wells will be purged and sampled using low-flow sampling techniques to remain consistent with the previous sampling techniques used at the site (FOP #1). These samples will be analyzed for VOCs, MNA parameters, and PCBs (at four monitoring wells) in order to obtain a final round of analytical data for this set of wells prior to demolition.

Air Sparge System Startup and Performance Monitoring

Performance monitoring will be performed in the weeks following startup of the remediation system to confirm that air is being distributed along the entire length of the well screen and saturated thickness of the aquifer and to optimize system operations.

Performance monitoring will include measurements of water levels, wellhead pressures (FOP #2), dissolved oxygen, and oxidation-reduction potential (ORP), and contaminant concentrations in six existing monitoring well pairs (deep and shallow) located immediately upgradient and downgradient of the air sparge curtain.

The monitoring frequency and duration following system startup is as follows:

- Week 1: Collect water level measurements daily
- Month 1: Collect water level, wellhead pressures, dissolved oxygen, and ORP weekly
- Quarterly: Collect water level, wellhead pressures, dissolved oxygen, ORP, and groundwater samples to be analyzed for VOCs and dissolved arsenic

- After 1 year or when operational changes occur, the duration and frequency of performance monitoring will be evaluated and adjusted based on available data

Proposed performance monitoring wells include the shallow and deep well pairs at MW-11, MW-513, MW-514, MW-515, MW-528, and MW-529 (Figure 2).

The adjustment of monitoring points upgradient or downgradient of the air sparge curtain or along utility corridors will be evaluated based on performance monitoring data.

ISSM QA/QC and Baseline Soil Sampling

Prior to ISSM activities, PCB and TCE DNAPL will be delineated. Boreholes will be visually inspected for the presence of product or sheen to delineate the extent of DNAPL in two locations shown on Figures 4 and 5.

Collect groundwater grab samples from each borehole and inspect for presence or product. During soil mixing, field testing will be conducted for QA/QC purposes. Initially, more samples will be collected so that adjustments can be made to the mixing method, as necessary. During the first week of mixing, samples will be collected at three depths (bottom, middle, and top) of the first column mixed and two samples from a second location (bottom and middle) will be collected. After the first week, two samples will be collected (bottom and middle) from one sample location per day for iron content analysis.

Samples will be collected at discrete depths within the mixing columns, provided by the subcontractor, and handled in accordance with FOP #3. Two analyses will be conducted on these samples. One analysis will be a field test for iron content and the other will be a laboratory analysis to establish baseline (0-month) VOC concentrations. The iron content of the discrete sample will be analyzed by magnetic separation and water content testing as described in the attached FOP #4.

The iron content analysis will be completed by CH2M HILL to confirm adequate iron concentration and homogenous mixing has been achieved. If the results indicate that thorough mixing throughout the treatment area has not been achieved across the column (greater than 25 percent variation [ZVI range from 1.5 to 2.5 percent] or large visual observations of unmixed material), additional iron will be added and remixed and the number of passes through the mixing column will be increased on subsequent columns. The approximate ISSM area of interest for all sampling is shown on Figure 4.

ISSM Post-Mixing Soil Sampling

After mixing activities are completed, soil sampling will be conducted in accordance with FOP #5 at approximately 1, 6, and 12 months and analyzed for VOCs by USEPA Method 8260B on a standard turnaround time. As discussed in 2.4.3, the baseline, or 0-month, sample will be collected during mixing activities and in the same sample to mixed soil frequency as the 1-, 6-, and 12-month samples, but will require a quick turnaround time (72-hour) to determine accurate baseline concentrations. The approximate sampling frequency will be one location per 1,000 cubic yards of mixed soil. Each location will have two samples collected, one within 1 foot of the bottom and one at mid-depth, and analyzed for VOCs by

USEPA Method 8260B. It is assumed samples will be collected using a direct-push rig or similar equipment in accordance with FOP #6 to obtain soil cores to proper depth.

ISSM Temporary Performance Well Sampling

Groundwater sampling of two temporary performance wells located within the treatment area will be performed to monitor the changes in the groundwater concentrations over time following soil mixing activities.

Monitoring wells will be purged and sampled using low-flow sampling techniques to remain consistent with the previous sampling techniques used at the site (FOP #1). However, if water production does not allow low flow, grab samples will be collected within 24 hours of purging the wells dry.

Groundwater sampling will be performed on the same schedule as soil sampling at 1 month, 6 months, and 12 months following mixing activities and samples will be analyzed for VOCs as first priority if sample volume is limiting. If sample volume and methods allow, field parameters and samples for MNA parameter analysis will be collected. The two wells will be installed during mobilization for collection of the 1-month post-mixing soil samples.

EISB Baseline Monitoring

Monitoring wells will be purged and sampled using low-flow sampling techniques to remain consistent with the previous sampling techniques used at the site (FOP #1). Replacement wells will be developed following the procedures described in FOP #11.

Baseline samples will be collected from an estimated 40 monitoring wells (Figure 3) associated with the EISB five source zones and analyzed no greater than 90 days prior to injection in the five source zones.

The results of the groundwater samples will be used to establish baseline groundwater conditions in order to evaluate the EISB progress. The samples will be analyzed for VOCs, MNA parameters, VFAs, and TOC. Additionally, field measurements will be collected during monitoring.

EISB Performance Monitoring

Monitoring wells will be purged and sampled using low-flow sampling techniques to remain consistent with the previous sampling techniques used at the site (FOP #1).

Groundwater samples will be collected quarterly from an estimated 40 monitoring wells (Figure 3) associated with the EISB 5 source zones for 4 years to monitor the performance of the EISB remedy. The samples will be analyzed for VOCs, VFAs, and TOC, and field measurements will be collected during monitoring.

After the first year of EISB injections and performance monitoring, the analytical results will be used to determine when additional injections are required. If TOC concentrations in source zone monitoring wells are below 50 milligrams per liter (mg/L) and/or VFA

concentrations have decreased, indicating the substrate has been exhausted, an additional injection will be performed.

MNA Annual Sitewide Sampling

Monitoring wells will be purged and sampled using low-flow sampling techniques to remain consistent with the previous sampling techniques used at the site (FOP #1).

Each construction phase has specific short-term performance monitoring requirements. After the initial short-term performance of each component is verified, a total of 72 monitoring wells (Figure 3) on- and offsite will be sampled annually for an estimated 30 years to collect data on performance of the MNA remedy component. The 72 sitewide wells include the 40 wells associated with the five source zones and EISB performance monitoring.

Groundwater samples collected during the annual MNA monitoring will be analyzed for VOCs, dissolved arsenic, and MNA parameters, and field measurements will be collected during monitoring. Additionally, samples collected from the 40 wells associated with the EISB five source zones will be analyzed for VFAs and TOC.

Waste Characterization

Soil

Prior to soil removal, waste characterization soil samples will be collected to help the subcontractor develop a waste profile of the contaminated soil and gain acceptance from the offsite disposal facility. Drill cuttings and other soil waste will be generated during the drilling and installation of the air sparge well, EISB monitoring wells, and DNAPL delineation boreholes. Samples will be collected and analyzed for the parameters listed on Worksheet #11.

Water

Wastewater will be generated during predemolition groundwater monitoring—all phases of construction and subsequent groundwater performance monitoring events. All wastewater will require containerization and sample collection for analysis of parameters as defined in on Worksheet #1 prior to disposal.

Prior to wastewater removal, wastewater samples will be collected to help the subcontractor develop a waste profile of the wastewater and gain acceptance from the offsite disposal facility.

Upon completion of activities onsite, the subcontractor associated with each construction phase will arrange disposal of wastewater generated during activities. Wastewater generated during groundwater performance monitoring events will be containerized onsite and disposed of periodically.

Worksheet #18—Sampling Locations and Methods/SOP Requirements Table

(UFP-QAPP Manual Section 3.1.1)

Sampling Location/ID Number	Matrix	Depth	Analytical Group	Concentration Level	Number of Samples (+ FDs)	Sampling SOP Reference ^a	Rationale for Sampling Location
Predemolition	Groundwater	Screen Interval	VOCs	Low	35 (+ 4)	FOP #1	Obtain a final round of analytical data for this set of wells prior to demolition.
			MNA ^b	Low	35 (+ 4)	FOP #1	
			PCBs	Low	35 (+ 4)	FOP #1	
Air Sparge	Groundwater	Screen Interval	VOCs	Low	48 (+ 8)	FOP #1	Collect samples from monitoring wells hydraulically upgradient and downgradient of air sparge curtain.
			Dissolved Arsenic	Low	48 (+ 8)	FOP #1	Assess air sparge curtain zone of influence and COC concentrations.
In Situ Soil Mixing	Soil	Top (5 core locations); midpoint and 1 foot above bottom (25 core locations)	Iron Content	Low	55 (+ 0)	FOP #4	Confirm adequate iron concentration and homogenous mixing has been achieved.
		Midpoint and 1 foot above bottom	VOCs	Low	80 (+ 8)	FOP #5 FOP #6	Monitor changes in the soil concentrations over time following soil mixing activities and verify reduction percentages in comparison to baseline conditions.
	Groundwater	Screen Interval	VOCs	Low	8 (+ 4)	FOP #1	Monitor changes in the groundwater concentrations over time following soil mixing activities.
			Dissolved Gases	Low	8 (+ 4)	FOP #1	
			Dissolved Metals	Low	8 (+ 4)	FOP #1	
			MNA ^b	Low	8 (+ 4)	FOP #1	

Sampling Location/ ID Number	Matrix	Depth	Analytical Group	Concentration Level	Number of Samples (+ FDs)	Sampling SOP Reference ^a	Rationale for Sampling Location
Enhanced In Situ Bioremediation	Groundwater	Screen Interval	VOCs	Low	520 (+ 52) [40 (+ 4)/1 baseline and 40 (+4)/12 quarterly events]	FOP #1	Samples will be collected from select source zone monitoring wells to determine injection frequency and to verify EISB conditions are present.
			TOC & VFAs	Low	680 (+ 68) [40 (+4)/1 baseline and 40 (+4)/16 quarterly events]	FOP #1	
			Dissolved Gases	Low	40 (+ 4)	FOP #1	
			Dissolved Metals	Low	40 (+ 4)	FOP #1	
			MNA ^b	Low	40 (+ 4)	FOP #1	
MNA	Groundwater	Screen Interval	VOCs	Low	2160 (+ 240) [72 (+ 8)/30 events]	FOP #1	Provide analytical data to evaluate MNA sitewide.
			Dissolved Gases	Low	2160 (+ 240) [72 (+ 8)/30 events]	FOP #1	
			Dissolved Metals	Low	2160 (+ 240) [72 (+ 8)/30 events]	FOP #1	
			MNA ^b	Low	2160 (+ 240) [72 (+ 8)/30 events]	FOP #1	
			PCBs	Low	120 (+ 30) [4 (+ 1)/30 events]	FOP #1	

^aSpecify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #21).

^bMNA parameters include the following: alkalinity, nitrate/nitrite, chloride, dissolved iron, dissolved manganese, sulfate, and sulfide.

Worksheet #19—Analytical SOP Requirements Table

(UFP-QAPP Manual Section 3.1.1)

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference ^a	Containers (number, size, and type)	Preservation Requirements	Maximum Holding Time (preparation/ analysis)
Groundwater	TCLP Volatiles	Low	LAB SOP #1	3 x 40 mL glass vials	HCl to pH < 2, 4°C	14 days
Groundwater	Dissolved Gases	Low	LAB SOP #2	3 x 40 mL glass vials	HCl to pH < 2, 4°C	14 days
Groundwater	Dissolved Metals	Low	LAB SOP #3	500 mL plastic	HNO ₃ to pH < 2, 4°C	180 days (Hg, 28 days)
Groundwater	MNA	Low	LAB SOP #4 Alkalinity LAB SOP #5 Chloride LAB SOP #6 Nitrate/Nitrite LAB SOP #7 Sulfate	500 mL plastic	4°C	14 days 28 days 48 hours/48 hours (or 28 days) 28 days
Groundwater	MNA	Low	LAB SOP #8 Sulfide	500 mL plastic	NaOH + ZnAc, 4°C	7 days
Groundwater	TOC	Low	LAB SOP #9 TOC	125 mL plastic	H ₂ SO ₄ to pH < 2, 4°C	28 days
Groundwater	VFA	Low	LAB SOP #10 Volatile Fatty Acids	2 x 40 mL glass vial	4°C	28 days
Groundwater	PCBs	Low	LAB SOP #11 PCBs	2 x 1 L amber glass	4°C	7 days to extraction; 40 days to analysis
Soil	VOCs	Low	LAB SOP #1	25g Encore sampler	4°C (or 4°C and methanol)	48 hours (or if preserved 14 days)
Soil	SVOCs	Low	CLP SOW SOM01.1 or USEPA SW-846 8270C	1 x 250 mL glass jar with Teflon lined cap	4°C	14 days to extraction; 40 days to analysis
Soil	PCBs	Low	CLP SOW SOM01.1 or USEPA SW-846 8082	1 x 250 mL glass jar with Teflon lined cap	4°C	14 days to extraction; 40 days to analysis
Soil	TCLP VOCs	Low	USEPA SW-846 1311/8260B	1 x 4 oz glass, no head space	4°C, MeOH	14 days to TCLP, 14 days to analysis after TCLP

Handwritten note:
(Multiple) samples for each parameter

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference ^a	Containers (number, size, and type)	Preservation Requirements	Maximum Holding Time (preparation/ analysis)
Soil	TCLP SVOCs	Low	USEPA SW-846 1311/8270C	1 x 8 oz amber glass	4°C	14 days to TCLP, 7 days to extract, 40 to analyze after extract
Soil	TCLP Metals	Low	USEPA SW-846 1311/6010B or 7000 series (Hg)	1 x 8 oz amber glass	4°C	14 days to TCLP, 180 days to digest and analyze (28 days for Hg)
Soil	pH	Low	USEPA SW-846 9045C	1 x 4 oz plastic	4°C	ASAP
Soil	Specific Gravity	Low	SM 2710F	1 x 4 oz plastic	4°C	N/A
Soil	Total Solids	Low	SM 2540B	1 x 4oz plastic	4°C	7 days
Soil	Free Liquids	Low	USEPA SW-846 9095A	1 x 4oz plastic	4°C	180 days
Soil	Flash Point	Low	USEPA SW-846 1010	1 x 4oz plastic	4°C	10 days
Soil	Reactive Cyanide	Low	USEPA SW-846 9012A	1 x 4oz plastic	4°C	14 days
Soil	Reactive Sulfide	Low	D4978	1 x 4oz plastic	4°C	N/A

^aSpecify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #23).

Worksheet #20—Field Quality Control Sample Summary Table

(UFP-QAPP Manual Section 3.1.1)

Matrix	Analytical Group	Concentration Level	Analytical and Preparation SOP Reference ^a	Number of Sampling Locations	Number of Field Duplicate Pairs	Number of MS/MSDs	Total Number of Samples ^b
Pre-Demolition							
Groundwater	VOCs	Low	LAB SOP #1	35	4	2	39
	Dissolved Gases	Low	LAB SOP #2	35	4	2	39
	Dissolved Metals	Low	LAB SOP #3	35	4	2	39
	MNA	Low	LAB SOP #4-8	35	4	2	39
	PCBs	Low	LAB SOP #11	35	4	2	39
Air Sparge							
Groundwater	TCL Volatiles	Low	LAB SOP #1	48 (12/event)	8 (2/event)	4 (1/event)	56
	Dissolved Arsenic	Low	LAB SOP #3	48 (12/event)	8 (2/event)	4 (1/event)	56
In Situ Soil Mixing							
Soil	Iron Content	Low	FOP #4	55	N/A	N/A	55
	TCL Volatiles	Low	LAB SOP #1	80 (20/event)	8 (2/event)	4 (1/event)	88
Groundwater	TCL Volatiles	Low	LAB SOP #1	8 (2/event)	4 (1/event)	4 (1/event)	12
	Dissolved Gases	Low	LAB SOP #2	8 (2/event)	4 (1/event)	4 (1/event)	12
	Dissolved Metals	Low	LAB SOP #3	8 (2/event)	4 (1/event)	4 (1/event)	12
	MNA	Low	LAB SOP #4-10	8 (2/event)	4 (1/event)	4 (1/event)	12

Matrix	Analytical Group	Concentration Level	Analytical and Preparation SOP Reference ^a	Number of Sampling Locations	Number of Field Duplicate Pairs	Number of MS/MSDs	Total Number of Samples ^b
Enhanced In Situ Bioremediation – Performance Monitoring							
Groundwater	Iron Content	Low	FOP #4	55	NA	NA	55
	TCL Volatiles	Low	LAB SOP #1	520 (40/event)	52 (4/event)	26 (2/event)	572
	Dissolved Gases	Low	LAB SOP #2	40	4	2	44
	Dissolved Metals	Low	LAB SOP #3	40	4	2	44
	MNA	Low	LAB SOP #4-8	40	4	2	44
	TOC	Low	LAB SOP #9	680 (40/event)	68 (4/event)	34 (2/event)	748
	VFA	Low	LAB SOP #10	680 (40/event)	68 (4/event)	34 (2/event)	748
Enhanced In Situ Bioremediation – MNA							
Groundwater	TCL Volatiles	Low	LAB SOP #1	2160 (72/event)	240 (8/event)	120 (4/event)	2,400
	Dissolved Gases	Low	LAB SOP #2	2160 (72/event)	240 (8/event)	120 (4/event)	2,400
	Dissolved Metals	Low	LAB SOP #3	2160 (72/event)	240 (8/event)	120 (4/event)	2,400
	MNA	Low	LAB SOP #4-8	2160 (72/event)	240 (8/event)	120 (4/event)	2,400
	PCBs	Low	LAB SOP #11	120 (4/event)	30 (1/event)	30 (1/event)	150

^aSpecify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #23).

^bTotal number of samples does not include MS/MSDs.
 MS = matrix spike, MSD = matrix spike duplicate

Worksheet #21—Project Sampling SOP References Table

(UFP-QAPP Manual Section 3.1.2)

Reference Number	Title, Revision Date and/or Number	Originating Organization	Equipment Type	Modified for Project Work? (Check if yes)	Comments
FOP #1	Low-Flow Sampling	CH2M HILL		<input type="checkbox"/>	
FOP #2	AS Wellhead Pressure Measurements	CH2M HILL		<input type="checkbox"/>	
FOP #3	ISSM QAQC and Baseline Soil Sampling	CH2M HILL		<input type="checkbox"/>	
FOP #4	Iron Content Analysis	CH2M HILL		<input type="checkbox"/>	
FOP #5	VOC Soil Sample Collection	CH2M HILL		<input type="checkbox"/>	
FOP #6	Direct Push Sample Collection	CH2M HILL		<input type="checkbox"/>	
FOP #7	Sample Handling, Packaging, and Shipment	CH2M HILL	Procedural guidance	<input type="checkbox"/>	
FOP #8	Documentation and Chain-of-Custody Procedures	CH2M HILL	Procedural guidance	<input type="checkbox"/>	
FOP #9	Field Logbook	CH2M HILL	Procedural guidance	<input type="checkbox"/>	
FOP #10	Decontamination of Equipment and Personnel	CH2M HILL	Procedural guidance	<input type="checkbox"/>	
FOP #11	Monitoring Well Installation and Development	CH2M HILL		<input type="checkbox"/>	



Worksheet #22—Field Equipment Calibration, Maintenance, Testing, and Inspection Table

(UFP-QAPP Manual Section 3.1.2.4)

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference ^a
Digital Scale	Calibrate with weights	Model specific, per manufacturer's recommendation	Mass	Daily	Model specific, per manufacturer's recommendation	As needed per SOP	Field Team Leader	TBD, model and manufacturer specific
Multiprobe Water Quality Meter	Calibrate with standards	Model specific, per manufacturer's recommendation	pH, dissolved oxygen, ORP, temperature, conductivity, turbidity	Daily	Model specific, per manufacturer's recommendation	As needed per SOP	Field Team Leader	TBD, model and manufacturer specific
Photoionization detector	Calibrate with standards	Model specific, per manufacturer's recommendation		Daily	Model specific, per manufacturer's recommendation	As needed per SOP	Field Team Leader	TBD, model and manufacturer specific
Combustible gas/oxygen/hydrogen sulfide monitors	Calibrate with standards	Model specific, per manufacturer's recommendation		Daily	Model specific, per manufacturer's recommendation	As needed per SOP	Field Team Leader	TBD, model and manufacturer specific

^aSpecify the appropriate reference letter or number from the Project Sampling SOP References table (Worksheet #21).



Worksheet #23—Analytical SOP References Table

(UFP-QAPP Manual Section 3.2.1)

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work?
LAB SOP #1	SOM01.2 or SW-846 8260B	Definitive	VOCs	GC/MS	CLP or Contract Lab	<input type="checkbox"/>
LAB SOP #2	RSK 175	Definitive	Dissolved Gases	GC/MS	Contract Lab	<input type="checkbox"/>
LAB SOP #3	ILM05.4 or SW-846 6010B	Definitive	Dissolved Metals	ICP-AES	CLP or Contract Lab	<input type="checkbox"/>
LAB SOP #4	SM 2320B or EPA 310.1	Definitive	Alkalinity	Titration	Contract Lab	<input type="checkbox"/>
LAB SOP #5	SW-846 9056 or EPA 300.0	Definitive	Chloride	Ion Chromatograph	Contract Lab	<input type="checkbox"/>
LAB SOP #6	SW-846 9056 or EPA 300.0	Definitive	Nitrate/ Nitrite	Ion Chromatograph	Contract Lab	<input type="checkbox"/>
LAB SOP #7	EPA 300.0	Definitive	Sulfate	Ion Chromatograph	Contract Lab	<input type="checkbox"/>
LAB SOP #8	EPA 376.1	Definitive	Sulfide	Titration	Contract Lab	<input type="checkbox"/>
LAB SOP #9	SW-846 9060 or EPA 415.1	Definitive	Total Organic Carbon	Carbonaceous Analyzer	Contract Lab	<input type="checkbox"/>
LAB SOP #10	SW-846 9056 Modified	Definitive	Volatile Fatty Acids	Ion Chromatograph	Contract Lab	<input type="checkbox"/>
LAB SOP #11	SOM01.2 or SW-846 8082	Definitive	PCBs	GC/ECD	CLP or Contract Lab	<input type="checkbox"/>
LAB SOP TBD	Sample Management (receiving, storage, chain of custody)	N/A	All	N/A	Contract Lab	<input type="checkbox"/>
LAB SOP TBD	Sample disposal	N/A	All	N/A	Contract Lab	<input type="checkbox"/>

MS = matrix spike



Worksheet #24—Analytical Instrument Calibration Table

(UFP-QAPP Manual Section 3.2.2)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Action	SOP Reference ^a
GC/MS	DFTPP tuning	Prior to initial calibration and calibration verification (every 12 hours)	Refer to criteria listed in the method	Retune instrument and verify	Lab analyst	LAB SOP #1 and #2
GC/MS	Multipoint initial calibration (minimum five points)	Prior to sample analysis, or when calibration verification fails	<p>SPCCs average RF ≥ 0.050 and %RSD for RFs for CCCs $\leq 30\%$ and one option below:</p> <p>Option 1:</p> <p>Mean %RSD for all analytes $\leq 15\%$ with no individual analyte RSD $> 30\%$, if using average RRFs</p> <p>Option 2:</p> <p>Least squares regression $r \geq 0.990$</p>	Correct the problem and repeat the initial calibration	Lab analyst	LAB SOP #1 and #2
GC/MS	Second-source calibration verification	Once for each multipoint initial calibration	All analytes within $\pm 25\%$ of expected value	Correct the problem and repeat initial calibration	Lab analyst	LAB SOP #1 and #2
GC/MS	Continuing calibration verification	At the start of each analytical sequence and every 12 hours thereafter	<p>SPCCs average RF ≥ 0.050 and %D for RFs for CCCs $\leq 20\%$</p> <p>All other analytes within $\pm 20\%$ of expected value</p>	Correct the problem, then recalibrate and reanalyze all samples since the last acceptable continuing calibration verification	Lab analyst	LAB SOP #1 and #2
ICP-AES	Initial calibration (a blank and at least one standard)	Before sample analysis, every 24 hours, whenever modifications are made to the system, or when continuing calibration verification fails	If more than one standard is used, correlation coefficient must be > 0.995	N/A	Lab analyst	LAB SOP #3

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Action	SOP Reference ^a
ICP-AES	Second-source calibration verification	Immediately following each initial calibration	All analytes within $\pm 10\%$ of expected value for SW6010B and within $\pm 5\%$ of expected value for EPA200.7	Correct problem and repeat initial calibration	Lab analyst	LAB SOP #3
ICP-AES	Calibration blank	After every Second-source or Continuing calibration verification analysis	No analytes detected at or above the reporting limit	Correct the problem, then reanalyze previous 10 samples	Lab analyst	LAB SOP #3
ICP-AES	Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	All analytes within $\pm 10\%$ of expected value for SW6010B and within $\pm 10\%$ of expected value for EPA200.7	Recalibrate and reanalyze all samples since the last acceptable continuing calibration verification	Lab analyst	LAB SOP #3
ICP-AES	Linear Range Calibration check standard	Once per quarter	All analytes within $\pm 10\%$ of expected value	Correct problem then reanalyze or re-set linear range	Lab analyst	LAB SOP #3
Ion Chromatograph	Multi-point initial calibration (a blank and at least five standards) – does not apply to titrimetric method	Before initial sample analysis, every 24 hours, whenever modifications are made to the analytical system, or when continuing calibration verification fails	Correlation coefficient of linear regression is ≥ 0.995	Correct the problem and repeat the initial calibration	Lab analyst	LAB SOP #5, #6, #7, and #10
Ion Chromatograph	Second-source calibration verification	Immediately following each initial calibration	Analytes within $\pm 15\%$ ($\pm 10\%$ for SW9056/EPA300.0) of expected value	Correct the problem and repeat initial calibration	Lab analyst	LAB SOP #5, #6, #7, and #10
Ion Chromatograph	Calibration blank – does not apply to titrimetric method	After every Second-source or Continuing calibration verification analysis	No analytes detected at or above the reporting limit	Correct the problem, then reanalyze previous 10 samples	Lab analyst	LAB SOP #5, #6, #7, and #10

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for	
					Corrective Action	SOP Reference ^a
Ion Chromatograph	Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	Within $\pm 15\%$ ($\pm 10\%$ for SW9056/EP300.0) of expected value	Recalibrate and reanalyze all samples since the last acceptable continuing calibration verification	Lab analyst	LAB SOP #5, #6, #7, and #10
GC/ECD	Initial Calibration	Prior to sample analysis, or when continuing calibration fails for a second time	%RSD of 80% of the calibrated peaks must be $< 30\%$. Up to 20% of the calibrated peaks may have %RSDs $\geq 30\%$ as long as they are all $< 40\%$. Any component for which the least squares regression analysis of the line that defines the calibration curve is > 0.995 will be exempted from the requirement of having the %RSD of $< 30.0\%$	Correct the problem and repeat the initial calibration	Lab analyst	LAB SOP #11
GC/ECD	Continuing Calibration	Prior to sample analysis and every 24 hours thereafter	RPD of 80% of the calibrated peaks must be $< 30\%$. Up to 20% of the compounds may have RPDs $\geq 30\%$ as long as they are $< 40\%$	Correct the problem, then recalibrate and reanalyze all samples since the last acceptable continuing calibration	Lab analyst	LAB SOP #11

^aSpecify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #23).
 DFTPP = decafluorotriphenylphosphine; %D = Percent Drift; %RSD = Percent Relative Standard Deviation;
 CC = Continuing Calibration; RRF = Relative Response Factor; IC = Initial Calibration; SPCC = System Performance Check Compound; RF = Response Factor; CCC = Calibration Check Compound, MS = matrix spike

Worksheet #25—Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

(UFP-QAPP Manual Section 3.2.3)

☒ Worksheet Not Applicable (State Reason)

The CLP and contract laboratory will keep all maintenance, testing, and inspection records on file at the laboratory.

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference ^a

^aSpecify the appropriate reference letter or number from Analytical SOP References Table (Worksheet #23).



Worksheet #26—Sample Handling System

(UFP-QAPP Manual Appendix A)

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT

Sample Collection (Personnel/Organization): Field Team Leader/CH2M HILL

Sample Packaging (Personnel/Organization): Field Team Leader/CH2M HILL

Coordination of Shipment (Personnel/Organization): Field Team Leader/CH2M HILL

Type of Shipment/Carrier: Fed Ex Overnight

SAMPLE RECEIPT AND ANALYSIS

Sample Receipt (Personnel/Organization): CLP or Contract Laboratory

Sample Custody and Storage (Personnel/Organization): CLP or Contract Laboratory

Sample Preparation (Personnel/Organization): CLP or Contract Laboratory

Sample Determinative Analysis (Personnel/Organization): CLP or Contract Laboratory

SAMPLE ARCHIVING

Field Sample Storage (No. of days from sample collection): See QAPP Worksheet #19 for allowable holding time

Sample Extract/Digestate Storage (No. of days from extraction/digestion): See QAPP Worksheet #19 for allowable holding time

Biological Sample Storage (No. of days from sample collection): N/A

SAMPLE DISPOSAL

Personnel/Organization: CLP or Contract Laboratory

Number of Days from Analysis: TBD by CLP or Contract Laboratory



Worksheet #27—Sample Custody Requirements

(UFP-QAPP Manual Section 3.3.3)

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory)

Sample handling, packaging, and shipment will be performed per FOP #7 Documentation/Chain-of-Custody Procedures, and FOP #8, Sample Handling, Packaging, and Shipment.

Sample coolers will be shipped to arrive at the CLP or independent laboratories the morning after sampling (priority overnight) or will be sent by a courier to arrive the same day. For non-CLP samples analyzed at an independent laboratory, the laboratory will be notified of the sample shipment and the estimated date of arrival of the samples being delivered.

Regulations for packaging, marking/labeling, and shipping of hazardous materials and wastes are promulgated by the United States Department of Transportation. Air carriers that transport hazardous materials, in particular Federal Express, require compliance with the current edition of the International Air Transport Association Dangerous Goods Regulations, which applies to shipment and transportation of hazardous materials by air carrier. Following current International Air Transport Association regulations will ensure compliance with United States Department of Transportation.

Laboratory Sample Custody Procedures (receipt of samples, archiving, disposal)

Upon sample receipt, the laboratory sample custodian will verify package seals, open the packages, check temperature blanks (and record temperatures), verify sample integrity, and inspect contents against chain-of-custody forms. The laboratory project manager will be contacted to resolve any discrepancies between sample containers and chain-of-custody forms. Once the shipment and chain-of-custody form are in agreement, the sample custodian will initiate an internal chain-of-custody form, as well as supply the laboratory task manager with a sample acknowledgement letter. When applicable, sample preservation will be checked and pH documented. If the sample temperatures are outside the required range, the laboratory will contact the project manager or the contractor as to the proper course of action.

Samples will be logged in and assigned a unique laboratory number for each sample. This number will be used by all laboratory personnel handling samples, to ensure all sample information is captured. Analyses required will be specified by codes assigned to samples at login. Labels containing the laboratory sample number are generated and placed on sample bottles.

After the laboratory labels the samples, they will be moved to locked refrigerators where they will be maintained at 4°C.

When samples are required, an appropriate member of the sample management department will locate the samples in the locked refrigerator, sign and date the internal sample tracking form, and provide the sample(s) to the analyst. When the analyst is finished with samples, unused portions will be returned to an appropriate member of the sample management department for replacement in a secure refrigerator. The analyst will sign and date internal chain-of-custody forms. In the event that entire samples are depleted during analysis, a notation of "sample depleted" or "entire sample used" will be written on the internal chain-of-custody forms.

Sample extracts will be stored in designated secure, refrigerated storage areas. Samples and sample extracts will be maintained in secure storage until disposal. No samples or extracts will be disposed of without prior written approval from an appropriate member of the project team. The sample custodian will note the sample disposal date in the sample ledger. The laboratory will dispose of samples in accordance with applicable regulations.

Documentation will be placed in a single, secured project file, maintained by the laboratory project manager. This file will consist of these components: agreements, correspondence, memorandums, notes, and data.

Reports (including QA reports) will be filed with correspondence. Analytical laboratory documentation and field data will be filed with notes and data. Filed materials may only be removed by authorized personnel on a temporary basis. The name of the person removing the file will be recorded. Laboratories will retain project files and data packages for a minimum of 7 years, unless otherwise agreed.

Sample Identification Procedures

A sample numbering system will be used to identify each sample, including duplicate and blank samples. The sample number will be a unique identifier. In the case of the DNAPL delineation samples, which will only be a visual observation, no sample numbering system will be required. Each borehole shall be assigned a numerical value, and the results of the inspection of each borehole will be documented in the field notes.

Each sample, regardless of analytical protocol, will also be assigned a CH2M HILL site-specific identifier, which will contain a site- and sample-specific location identifier that indicates where the sample was obtained. Subsurface soil samples will also use a numbering system that will include the sample depth.

The sample number and station location identifier will be included on the sample tag and the traffic report and chain-of-custody record.

The site-specific identifier is based on the following system:

- **Site – OMC**
- **Station Location** – The station location identifier is the unique name of the sampling location (e.g., soil mixing column, monitoring well, etc.). The location name will vary depending on the reason for sampling and the numeric location number assigned to that location.
 - The first letters indicate one of the types of sample locations listed in Table 2.

- The three number location codes are sequentially generated based upon the order that the sampling is performed.

Location codes for the remedial action will start with the 300 series (e.g., 300, 301, 302, etc.) to differentiate them from any remedial investigation sample locations.

TABLE 2
 Sample Location Types—Sample Identification

Sample Type
DW = Decontamination Water
MW-XX = Monitoring Well ID for Groundwater Samples
SO = Soil matrix from direct push, hand trowel, or soil mixing
WA = Waste Characterization

- **QC Samples**—Field duplicates will have an “R” appended to the end of the station location identifier. Matrix spike/matrix spike duplicates (MS/MSDs) are not identified in the station location identifier, but on the tag and the chain-of-custody form. Trip blank identifiers are “TB,” field blanks “FB,” and equipment blanks “EB.” QC samples will be sequentially numbered, and a record of those assigned will be kept in the field log book.

Examples

- OMC-MW-11 is a groundwater sample (MW-XX) from MW-11.
- OMC-SO305-R is a field duplicate of soil sample OMC-SO305.

Depth Indicator—Depth indicator codes, if applicable, will follow the station location as indicated below:

- **Soil and Groundwater Grab Samples**—the sample depth will be appended to the station location and consist of a hyphen followed by the starting and bottom depth intervals and separated by a slash. This indicator will provide the depth that represents the start and end of the sample interval in feet below ground surface. For example, the sample depth designation will be “-5.0/7.5” for a sample collected from an interval of 5 to 7.5 feet below ground surface.

Chain-of-Custody Procedures

- Chains of custody will include, at a minimum, laboratory contact information, client contact information, sample information, and relinquished by/received by information (FOP #8). Sample information will include sample identification, date/time collected, number and type of containers, preservative information, analysis method, and comments. The chain of custody will also have the sampler’s name and signature. The chain of custody will link location of the sample from the field logbook to the laboratory receipt of the sample. The laboratory will use the sample information to populate the laboratory database for each sample.

Worksheet #28-1—QC Samples Table

(UFP-QAPP Manual Section 3.4)

Matrix: Groundwater

Analytical Group: TCL Volatiles

Concentration Level: Low

Sampling SOP: FOP #1

Analytical Method/SOP Reference: LAB SOP #1

Sampler's Name: Field Team Member

Field Sampling Organization: CH2M HILL

Analytical Organization: CLP or Contract Lab

No. of Sample Locations: 2,771

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)
Performance Check	Prior to IC, CC, and every 12 hours	Must meet method criteria.	Retune instrument and verify.	Lab analyst	
Method Blank	1/Extraction batch	All analytes < Reporting Limit	Correct problem, then reprepare and analyze MB and all samples processed with the contaminated blank.	Lab analyst	Accuracy/Bias
Matrix Spike/Matrix Spike Duplicate	1/20 Samples	35–125% Recovery and RPD < 30%	If the MS and/or MSD are outside of either accuracy or precision tolerances, flag MS/MSD results.	Lab analyst	Accuracy/Bias Precision
LCS	1/Extraction batch	35–125% Recovery	Correct problem then reprepare and analyze the LCS and all samples in the affected analytical batch.	Lab analyst	Sensitivity
Internal Standards	Every sample, spiked sample, standard, and MB	Area within -50% to +100% of IC midpoint std.	Inspect mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning.	Lab analyst	Precision
Surrogate Spike (organics)	Every sample, spiked sample, standard, and MB	Recovery within limits stated in method	Re-extract and reanalyze sample.	Lab analyst	Accuracy/Bias

LCS = laboratory control sample

Worksheet #28-2—QC Samples Table

(UFP-QAPP Manual Section 3.4)

Matrix: Soil
Analytical Group: TCL Volatiles
Concentration Level: Low
Sampling SOP: FOP #5 and #6
Analytical Method/ SOP Reference: LAB SOP #1
Sampler's Name: Field Team Member
Field Sampling Organization: CH2M HILL
Analytical Organization: CLP or Contract Lab
No. of Sample Locations: 80

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)
Performance Check	Prior to IC, CC, and every 12 hours	Must meet method criteria.	Retune instrument and verify.	Lab analyst	
Method Blank	1/Extraction batch	All analytes < Reporting Limit	Correct problem, then reprepare and analyze MB and all samples processed with the contaminated blank.	Lab analyst	Accuracy/Bias
Matrix Spike/Matrix Spike Duplicate	1/20 Samples	35–125% Recovery and RPD < 30%	If the MS and/or MSD are outside of either accuracy or precision tolerances, flag MS/MSD results.	Lab analyst	Accuracy/Bias Precision
LCS	1/Extraction batch	35–125% Recovery	Correct problem then reprepare and analyze the LCS and all samples in the affected analytical batch.	Lab analyst	Sensitivity
Internal Standards	Every sample, spiked sample, standard, and MB	Area within -50% to +100% of IC midpoint std.	Inspect mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning.	Lab analyst	Precision
Surrogate Spike (organics)	Every sample, spiked sample, standard, and MB	Recovery within limits stated in method	Re-extract and reanalyze sample.	Lab analyst	Accuracy/Bias

LCS = laboratory control sample

Worksheet #28-3—QC Samples Table

(UFP-QAPP Manual Section 3.4)

Matrix: Groundwater
Analytical Group: Dissolved Gases
Concentration Level: Low
Sampling SOP: FOP #1
Analytical Method/SOP Reference: LAB SOP #2
Sampler's Name: Field Team Member
Field Sampling Organization: CH2M HILL
Analytical Organization: Contract Lab
No. of Sample Locations: 2243

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)
Method Blank	1/Preparation and Analytical Batch	<RL	Correct problem, then reprepare and analyze method blank and all samples processed with the contaminated blank.	Lab analyst	Accuracy/Bias
Matrix Spike/Matrix Spike Duplicate	1/20 Samples	70–130% Recovery and RPD < 35%	If the MS and/or MSD are outside of either accuracy or precision tolerances, flag MS/MSD results.	Lab analyst	Accuracy/Bias Precision
Laboratory Duplicate	1/Analytical Batch	Concentration of reported analytes are > 5 times the reporting limit in either sample and RPD > 20%. One sample result < RL and a difference of ± 2 times the RL.	None	Lab analyst	Accuracy/Bias

Worksheet #28-4—QC Samples Table

(UFP-QAPP Manual Section 3.4)

Matrix: Groundwater
Analytical Group: Dissolved Metals
Concentration Level: Low
Sampling SOP: FOP #1
Analytical Method/ SOP Reference: LAB SOP #3
Sampler's Name: Field Team Member
Field Sampling Organization: CH2M HILL
Analytical Organization: CLP
No. of Sample Locations: 2291

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)
Preparation Blank	1/Analytical Batch	All analytes < Reporting Limit	Reanalyze PB. If fails, analyze a calibration blank. Reprep/reanalyze analytical batch as appropriate.	Lab analyst	Accuracy/Bias
Matrix Spike/Matrix Spike Duplicate	1/20 Samples	35–125% Recovery and RPD < 30%	If the MS and/or MSD are outside of either accuracy or precision tolerances, flag MS/MSD results.	Lab analyst	Accuracy/Bias Precision
Laboratory Duplicate	1/Analytical Batch	Concentration of reported analytes are > 5 times the reporting limit in either sample and RPD > 20%. One sample result < RL and a difference of ± 2 times the RL.	None	Lab analyst	Accuracy/Bias
Laboratory Control Sample	1/Analytical Batch	% Recovery within $\pm 15\%$ of true value	Correct problem, then reprepare and analyze the LCS and all samples in the affected analytical batch.	Lab analyst	Sensitivity

LCS = laboratory control sample

Worksheet #28-5—QC Samples Table

(UFP-QAPP Manual Section 3.4)

Matrix: Groundwater
Analytical Groups: MNA, TOC, VFA
Concentration Level: Low
Sampling SOP: FOP #1
Analytical Method/SOP Reference: LAB SOP #4-10
Sampler's Name: Field Team Member
Field Sampling Organization: CH2M HILL
Analytical Organization: Contract Lab
No. of Sample Locations: MNA - 2243
 TOC - 680
 VFA - 680

*Recovery
 75-125% 222
 Dissolved metals in
 Groundwater*

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)
Method Blank	1/Preparation and Analytical Batch	<RL	Correct problem, then reprepare and analyze method blank and all samples processed with the contaminated blank.	Lab analyst	Accuracy/Bias
Matrix Spike/Matrix Spike Duplicate	1/20 Samples	35–125% Recovery and RPD < 30%	If the MS and/or MSD are outside of either accuracy or precision tolerances, flag MS/MSD results.	Lab analyst	Accuracy/Bias Precision
Laboratory Duplicate	1/Analytical Batch	Concentration of reported analytes are > 5 times the reporting limit in either sample and RPD > 20%. One sample result < RL and a difference of ±2 times the RL.	None.	Lab analyst	Accuracy/Bias
Laboratory Control Sample	1/Analytical Batch	35–125% Recovery	Correct problem then reprepare and analyze the LCS and all samples in the affected analytical batch.	Lab analyst	Sensitivity

Worksheet #28-6—QC Samples Table

(UFP-QAPP Manual Section 3.4)

Matrix: Groundwater
Analytical Groups: PCBs
Concentration Level: Low
Sampling SOP: FOP #1
Analytical Method/SOP Reference: LAB SOP #11
Sampler's Name: Field Team Member
Field Sampling Organization: CH2M HILL
Analytical Organization: CLP or Contract Lab
No. of Sample Locations: 155

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)
Method Blank	1/Extraction Batch	All analytes < Reporting Limit	Correct problem, then reprep and analyze MB and all samples processed with the contaminated blank.	Lab analyst	Accuracy/Bias
Matrix Spike/Matrix Spike Duplicate	After initial calibration and every 12 hours	35–125% Recovery and RPD < 30%	If the MS and/or MSD are outside of either accuracy or precision tolerances flag MS/MSD results.	Lab analyst	Accuracy/Bias
Laboratory Duplicate	1/Extraction Batch	RPD +/- 30 %	Project Chemist will evaluate results for possible source of variability; notify data users.	Lab analyst	Precision
Laboratory Control Sample	1/Extraction Batch	35–125% Recovery	Correct problem then reprepare and analyze the LCS and all samples in the affected analytical batch.	Lab analyst	Sensitivity
Surrogate Spike (organics)	Every sample, spiked sample, standard, and MB	Recovery within limits stated in method	Correct the problem and reanalyze sample.	Lab analyst	Accuracy/Bias

LCS = laboratory control sample

Worksheet #29—Project Documents and Records Table

(UFP-QAPP Manual Section 3.5.1)

Sample Collection Documents and Records	Onsite Analysis Documents and Records	Offsite Analysis Documents and Records	Data Assessment Documents and Records	Other
Field Notes	Sample Receipt, Custody, and Tracking Records	Sample Receipt, Custody, and Tracking Records	Data Validation Reports	
Chain-of-Custody Records	Standards Traceability Logs	Standard Traceability Logs	Corrective Action Forms	
Air Bills	Equipment Calibration Logs	Equipment Calibration Logs	Telephone Logs	
Custody Seals	Sample Prep Logs	Sample Prep Logs		
Telephone Logs	Run Logs	Run Logs		
Corrective Action Forms	Equipment Maintenance, Testing, and Inspection Logs	Equipment Maintenance, Testing, and Inspection Logs		
	Corrective Action Forms	Corrective Action Forms		
	Reported Field Sample Results	Reported Field Sample Results		
	Sample Disposal Records	Reported Results for Standards, QC Checks, and QC Samples		
	Telephone Logs	Instrument Printout (raw data) for Field Samples, Standards, QC Checks, and QC Samples		
		Data Package Completeness Checklists		
		Sample Disposal Records		
		Telephone Logs		
		Extraction/Cleanup Records		
		Raw Data (stored on disk or CD-R)		
		QA Review Records		
		Hardcopy Report		



Worksheet #30—Analytical Services Table

(UFP-QAPP Manual Section 3.5.2.3)

Matrix	Analytical Group	Concentration Level	Sample Location/ID Numbers	Analytical SOP	Data Package Turnaround Time	Laboratory/Organization	Backup Laboratory/Organization
						(Name, Address, Contact Person, and Telephone Number)	(Name, Address, Contact Person, and Telephone Number)
Groundwater	VOCs	Low	Monitoring Wells Temp Well Point	LAB SOP #1	Sample Results – 72 hours or 7 days Full Package – 21 days	CLP or Contract Laboratory	Contract Laboratory
Soil	VOCs	Low	Soil Mixing Area	LAB SOP #1	Full Package – 21 days	CLP or Contract Laboratory	Contract Laboratory
Groundwater	Dissolved Gases	Low	Monitoring Wells Temp Well Point	LAB SOP #2	Full Package – 21 days	Contract Laboratory	
Groundwater	Dissolved Metals	Low	Monitoring Wells Temp Well Point	LAB SOP #3	Full Package – 21 days	CLP	Contract Laboratory
Groundwater	MNA	Low	Monitoring Wells Temp Well Point	LAB SOP #4-8	Full Package – 21 days	Contract Laboratory	
Groundwater	TOC	Low	Monitoring Wells Temp Well Point	LAB SOP #9	Full Package – 21 days	Contract Laboratory	
Groundwater	VFA	Low	Monitoring Wells Temp Well Point	LAB SOP #10	Full Package – 21 days	Contract Laboratory	
Groundwater	PCBs	Low	Monitoring Wells	LAB SOP #11	Full Package – 21 days	CLP	Contract Laboratory



Worksheet #31—Planned Project Assessments Table

(UFP-QAPP Manual Section 4.1.1)

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (Title and Organizational Affiliation)	Person(s) Responsible for Responding to Assessment Findings (Title and Organizational Affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions (Title and Organizational Affiliation)	Person(s) Responsible for Monitoring Effectiveness of Corrective Action (Title and Organizational Affiliation)
Health and Safety Audit	Once per phase	Internal	CH2M HILL	Mark Orman, Health and Safety Operations Manager, CH2M HILL	Jewelle Keiser, Project Manager, CH2M HILL	Field Team Leader	Mark Orman, Health and Safety Operations Manager, CH2M HILL
Field Audit	Once per phase	Internal	CH2M HILL	TBD	Jewelle Keiser, Project Manager, CH2M HILL	Field Team Leader	TBD



Worksheet #32—Assessment Findings and Corrective Action Responses

(UFP-QAPP Manual Section 4.1.2)

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (Name, Title, Organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (Name, Title, Org.)	Timeframe for Response
Health and Safety Audit	Written Audit Report	Jewelle Keiser, Project Manager, CH2M HILL	3 to 5 business days	Letter and any verification documentation	Field Team Leader	24 hours after notification
Field Audit	Written Audit Report	Jewelle Keiser, Project Manager, CH2M HILL	3 to 5 business days	Letter and any verification documentation	Field Team Leader	24 hours after notification



Worksheet #33—QA Management Reports Table

(UFP-QAPP Manual Section 4.2)

Type of Report	Frequency (daily, weekly monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (Title and Organizational Affiliation)	Report Recipient(s) (Title and Organizational Affiliation)
Field Progress Report	1 per week		Field Team Leader	Jewelle Keiser, Project Manager, CH2M HILL
Health and Safety Audit	After audit		Mark Orman, Health and Safety Operations Manager, CH2M HILL	Jewelle Keiser, Project Manager, CH2M HILL
Field Audit	After audit		TBD	Jewelle Keiser, Project Manager, CH2M HILL
Data Validation Report	1 after all data are validated	60 days after project completion	Adrienne Korpela, Project Chemist, CH2M HILL	Jewelle Keiser, Project Manager, CH2M HILL
Final Project Report	1 after project completion	60 days after project completion	Jewelle Keiser, Project Manager, CH2M HILL	Kevin Adler, Region 5 Work Assignment Manager, USEPA



Worksheet #34—Verification (Step I) Process Table

(UFP-QAPP Manual Section 5.2.1)

Verification Input	Description	Internal/ External	Responsible for Verification (Name, Organization)
Field Notes	Field notes will be reviewed internally and placed in the site file. A copy of the field notes will be attached to the final report.	Internal	Field Team Leader
Chain-of-Custody and Shipping Forms	Chain-of-custody and shipping forms will be reviewed internally upon their completion and verified against the packed coolers they represent. The shippers' signature on the chain of custody should be initialed by the reviewer, a copy of the chain of custody retained in the site file, and the original and remaining copies taped inside the cooler for shipment.	Internal	Field Team Leader
Audit Report	Upon report completion, a copy of all audit reports will be placed in the site file. If corrective actions are required, a copy of the documented corrective action taken will be attached to the appropriate audit report in the site file. At the beginning of each week and at the completion of the site work, site file audit reports will be reviewed internally to ensure that all appropriate corrective actions have been taken and that corrective action reports are attached. If corrective actions have not been taken, the site manager will be notified to ensure no action is taken.	Internal	Gina Bayer, CH2M HILL
Laboratory Data	<p>All laboratory data packages will be verified externally by the laboratory performing the work for completeness and technical accuracy prior to submittal.</p> <p>All received data packages from the CLP will be verified externally according to the data validation procedures specified in USEPA National Functional Guidelines. All received data from the subcontracted laboratory will be verified according to the USEPA National Functional Guidelines, laboratory SOPs, and QAPP criteria.</p>	External and internal	CLP, Subcontracted Laboratory, USEPA, and CH2M HILL



Worksheet #35—Validation (Steps IIa and IIb) Process Table

(UFP-QAPP Manual Section 5.2.2)

Step IIa/IIb	Validation Input	Description	Responsible for Validation (Name, Organization)
IIa	SOPs	Ensure all sampling SOPs were followed.	Field Team Leader
IIa	SOPs	Ensure all analytical SOPs were followed.	USEPA
IIa	Documentation of method QC results	Establish that all method-required QC samples were run and met the required limits.	Adrienne Korpela, CH2M HILL
IIb	Onsite field data	All onsite field data will be reviewed against QAPP requirements for completeness and accuracy based on the field calibration records.	Field Team Leader
IIb	Documentation of QAPP QC sample results	Establish that all QAPP required QC samples were run and met required limits.	Adrienne Korpela, CH2M HILL
IIb	Project quantitation limits	Verify that all sample results met the project quantitation limit specified in the QAPP.	Adrienne Korpela, CH2M HILL



Worksheet #36—Validation (Steps IIa and IIb)

Summary Table

(UFP-QAPP Manual Section 5.2.2)

Step IIa/IIb	Matrix	Analytical Group	Concentration Level	Validation Criteria	Data Validator (title and organizational affiliation)
IIa	Groundwater	VOCs	Low	USEPA National Functional Guidelines, laboratory SOPs, and QAPP criteria	USEPA or CH2M HILL
IIa	Soil	VOCs	Low	USEPA National Functional Guidelines, laboratory SOPs, and QAPP criteria	USEPA or CH2M HILL
IIa	Groundwater	Dissolved Gases	Low	Laboratory SOPs and QAPP criteria	Project Chemist, CH2M HILL
IIa	Groundwater	Dissolved Metals	Low	USEPA National Functional Guidelines, laboratory SOPs, and QAPP criteria	USEPA or CH2M HILL
IIa	Groundwater	General Chemistry	Low	Laboratory SOPs, and QAPP criteria	Project Chemist, CH2M HILL

Worksheet #37—Usability Assessment

(UFP-QAPP Manual Section 5.2.3)

Summarize the usability assessment process and all procedures, including interim steps and any statistics, equations, and computer algorithms that will be used:

Field QA/QC samples and laboratory internal QA/QC samples are collected and analyzed to assess data usability. The individual Statements of Work (SOW) state acceptance criteria for precision and accuracy requirements for the QC samples to assess their usability. Completeness is the percentage of usable data obtained during the sampling event, and its acceptance criteria are project specific. Precision of laboratory analysis will be assessed by comparing the analytical results between the subcontracted laboratory and the CLP. The %RPD will be calculated using the following equation:

$$\%RPD = \{(S - D) / [(S + D) / 2]\} \times 100$$

Where: S=First laboratory value (Mobile Lab value)

D=Second laboratory value (CLP value)

When the %RPD is greater than 30 percent, the potential causes (data outliers, matrix interferences, etc.) will be investigated. Where chemicals are not detected, the reported detection limits will not be used to calculate a %RPD. The differences in the procedures and reporting limits are described in the laboratory SOPs.

Precision of laboratory analysis will be assessed by comparing the analytical results between MS/MSDs. The precision of the field sampling procedures will be assessed by reviewing FD sample results. The RPD will be calculated for the duplicate samples using the following equation:

$$\%RPD = \{(S - D) / [(S + D) / 2]\} \times 100$$

Where: S=First sample value (original value)

D=Second sample value (duplicate value)

As stated previously, the precision criteria for duplicate samples will be +30 percent. Sample results shall be qualified "J" as estimated in quantity when this QC limit is exceeded. The acceptable MS/MSD precision criterion is stated in the appropriate SOWs.

Accuracy of laboratory results will be assessed for compliance with the established QC criteria using the analytical results of MBs, reagent/preparation blanks, MS/MSD samples, and FBs. Laboratory results accuracy will be assessed for compliance with the established QC criteria described in the SOWs. The %R of laboratory control samples will be calculated using the following equation:

$$\%R = (A/B) \times 100$$

Where: A = The analyte concentration determined experimentally from the LCS

B = The known amount of concentration in the sample

The accuracy criteria for the QA/QC samples are those stated in the appropriate SOWs.

The data completeness of laboratory analyses results will be assessed for compliance with the amount of data required for decision making. Complete data are data that are not rejected. Data qualified with qualifiers such as a "J" or "UJ" are still deemed acceptable and can still be used to make project decisions. The completeness of the analytical data is calculated using the following equation:

$$\% \text{ Completeness} = [(\text{Valid data obtained}) / (\text{Total data planned})] \times 100$$

The percent completeness goal for this sampling event is 95 percent.

Representativeness is the degree to which sampling data accurately and precisely represent site conditions, and is dependent on sampling and analytical variability and the variability of environmental media at the site. Representativeness is a qualitative "measure" of data quality.

The goal of achieving representative data in the field starts with a properly designed and executed sampling program that carefully considers the overall data quality objectives (DQOs) for the project. Proper location controls and sample handling are critical to obtaining representative samples.

The goal of achieving representative data in the laboratory is measured by assessing accuracy and precision. A laboratory will provide representative data when all of the analytical systems are in control. Representativeness is, therefore, a redundant DQO for laboratory systems if proper analytical procedures are followed and holding times are met.

In addition, laboratories must demonstrate that the staff is qualified to perform the analyses, are certified, and are proficient with analytical methods being employed.

Comparability is the degree of confidence with which one data set can be compared to another. Comparability is a qualitative measure of data quality.

The goal of achieving comparable data in the field starts with a properly designed and executed sampling program that carefully considers the overall DQO for the project. Proper location controls and sample handling are critical to obtaining comparable samples.

The goal of achieving comparable data in the laboratory is measured by assessing accuracy and precision. A laboratory will provide comparable data when all of the analytical systems are in control. Comparability is, therefore, a redundant DQO for laboratory systems if proper analytical procedures are followed and holding times are met.

Sensitivity is defined as the ability of the method or instrument to detect the contaminant of concern and other target compounds at the level of interest.

Appropriate sampling and analytical methods have been selected that have method detection and quantification limits that support the achievement of the desired sensitivity and established performance criteria.

Describe the evaluative procedures used to assess overall measurement error associated with the project:

An assessment will be made as to whether the data are of sufficient quality to support them. The decision as to data sufficiency may be affected by the overall precision, accuracy, and completeness of the data as demonstrated by the data validation process. If the data are sufficient to achieve project objectives, the QA officer will release the data and work may proceed. If not, corrective action will be required.

Identify the personnel responsible for performing the usability assessment:

The usability assessment will be performed by a team of personnel at CH2M HILL. Jewelle Keiser, project manager, will be responsible for information in the usability assessment and for assigning task work to the task members who will be supporting the usability assessment.

Describe the documentation that will be generated during usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies:

Data tables will be produced to reflect detected and non-detected site COCs as well as other parameters analyzed. Data qualifiers will be reflected in the tables and discussed in the data quality evaluation. Graphical representations will be produced to reflect spatial trends in COC concentrations. The results of the usability assessment will be presented in the final project report.

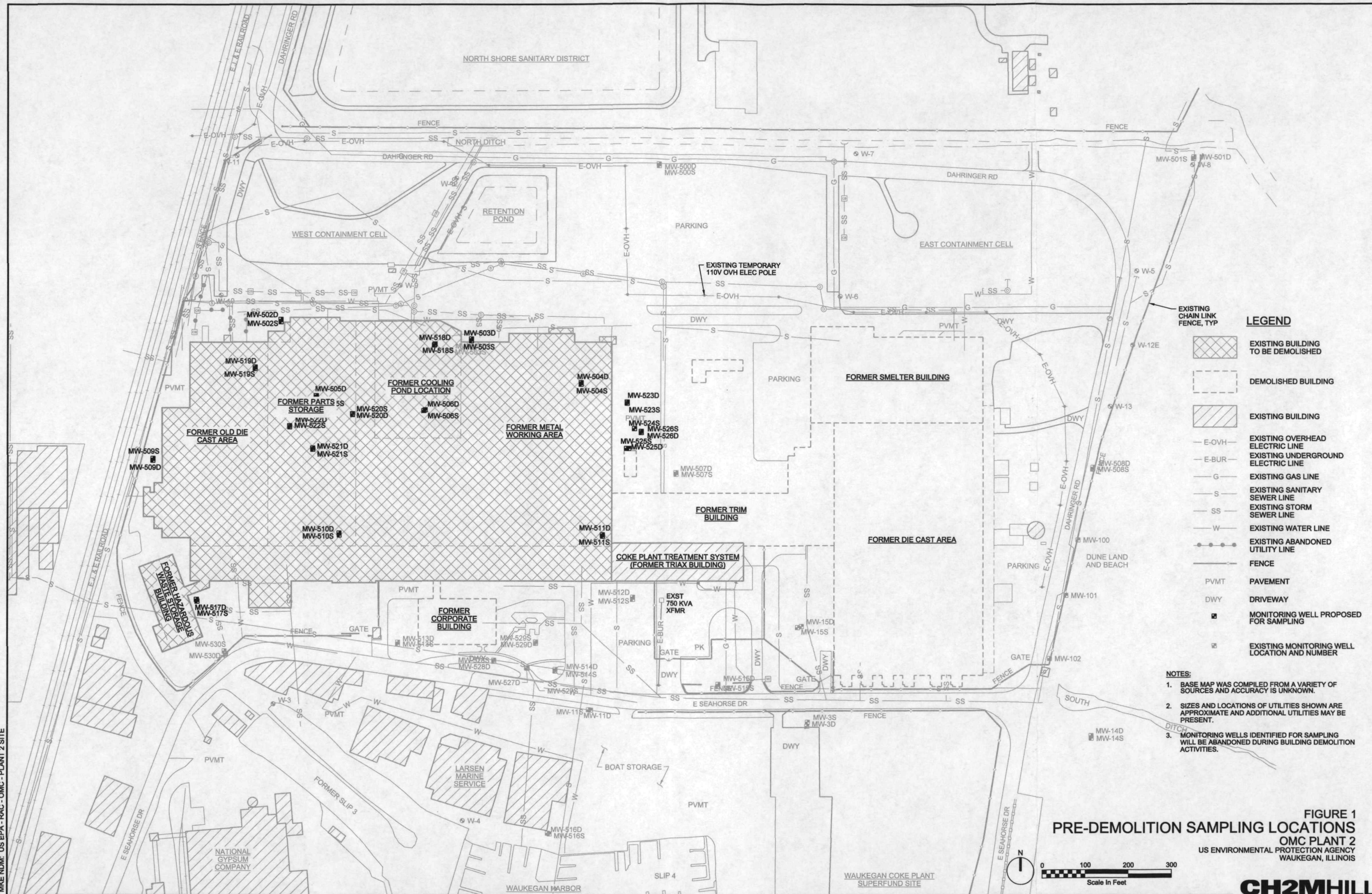
References

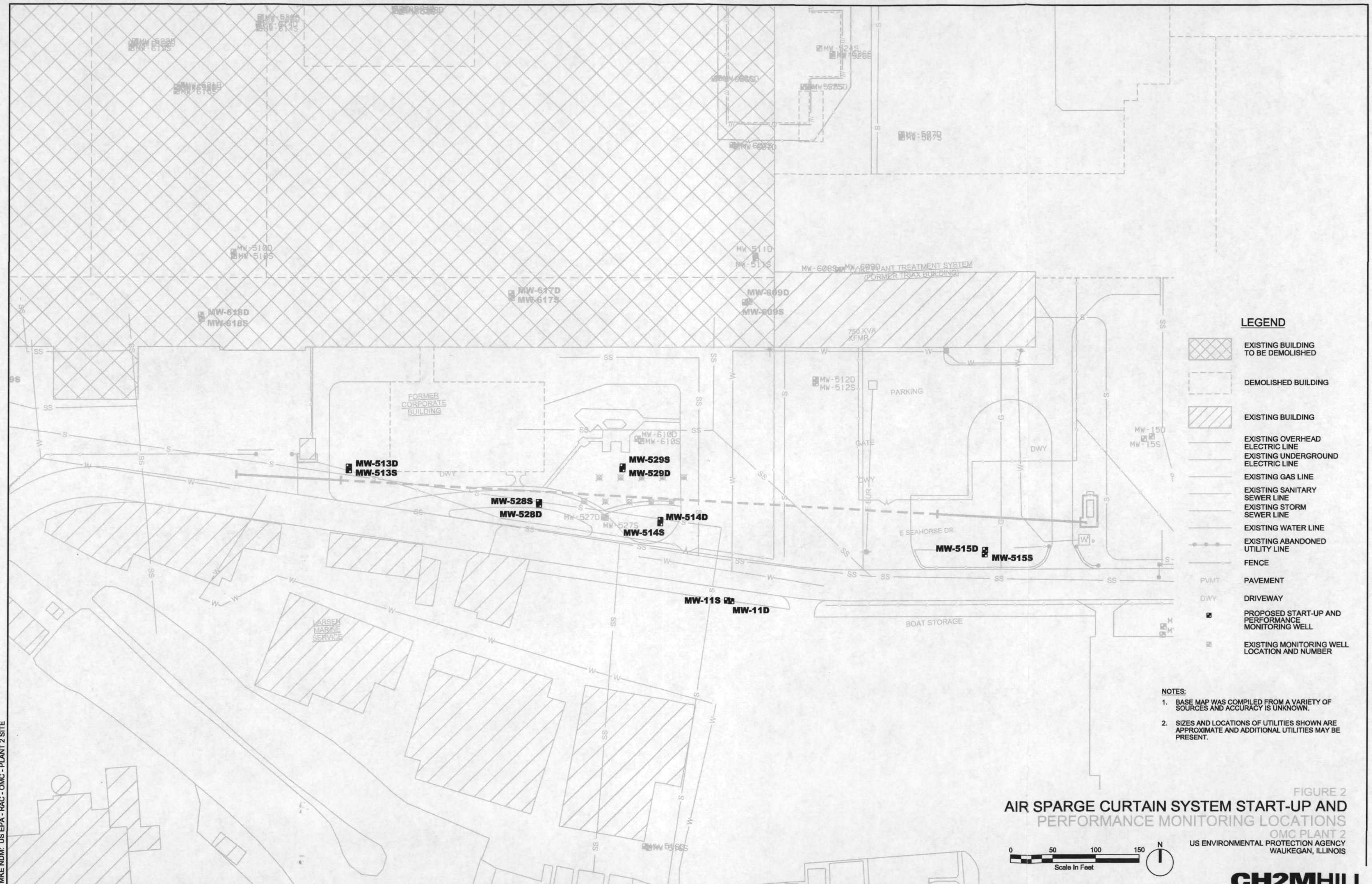
CH2M HILL. 2008a. *Enhanced In Situ Bioremediation Pilot Study Report*.

CH2M HILL. 2008b. *Supplemental Feasibility Study Report*.

CH2M HILL. 2006. *Feasibility Study Report*.

Figures





LEGEND

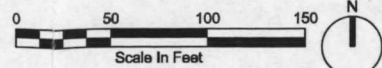
- EXISTING BUILDING TO BE DEMOLISHED
- DEMOLISHED BUILDING
- EXISTING BUILDING
- EXISTING OVERHEAD ELECTRIC LINE
- EXISTING UNDERGROUND ELECTRIC LINE
- EXISTING GAS LINE
- EXISTING SANITARY SEWER LINE
- EXISTING STORM SEWER LINE
- EXISTING WATER LINE
- EXISTING ABANDONED UTILITY LINE
- FENCE
- PAVEMENT
- DRIVEWAY
- PROPOSED START-UP AND PERFORMANCE MONITORING WELL
- EXISTING MONITORING WELL LOCATION AND NUMBER

NOTES:

1. BASE MAP WAS COMPILED FROM A VARIETY OF SOURCES AND ACCURACY IS UNKNOWN.
2. SIZES AND LOCATIONS OF UTILITIES SHOWN ARE APPROXIMATE AND ADDITIONAL UTILITIES MAY BE PRESENT.

FIGURE 2
AIR SPARGE CURTAIN SYSTEM START-UP AND
PERFORMANCE MONITORING LOCATIONS
OMC PLANT 2

US ENVIRONMENTAL PROTECTION AGENCY
WAUKEGAN, ILLINOIS



CH2MHILL

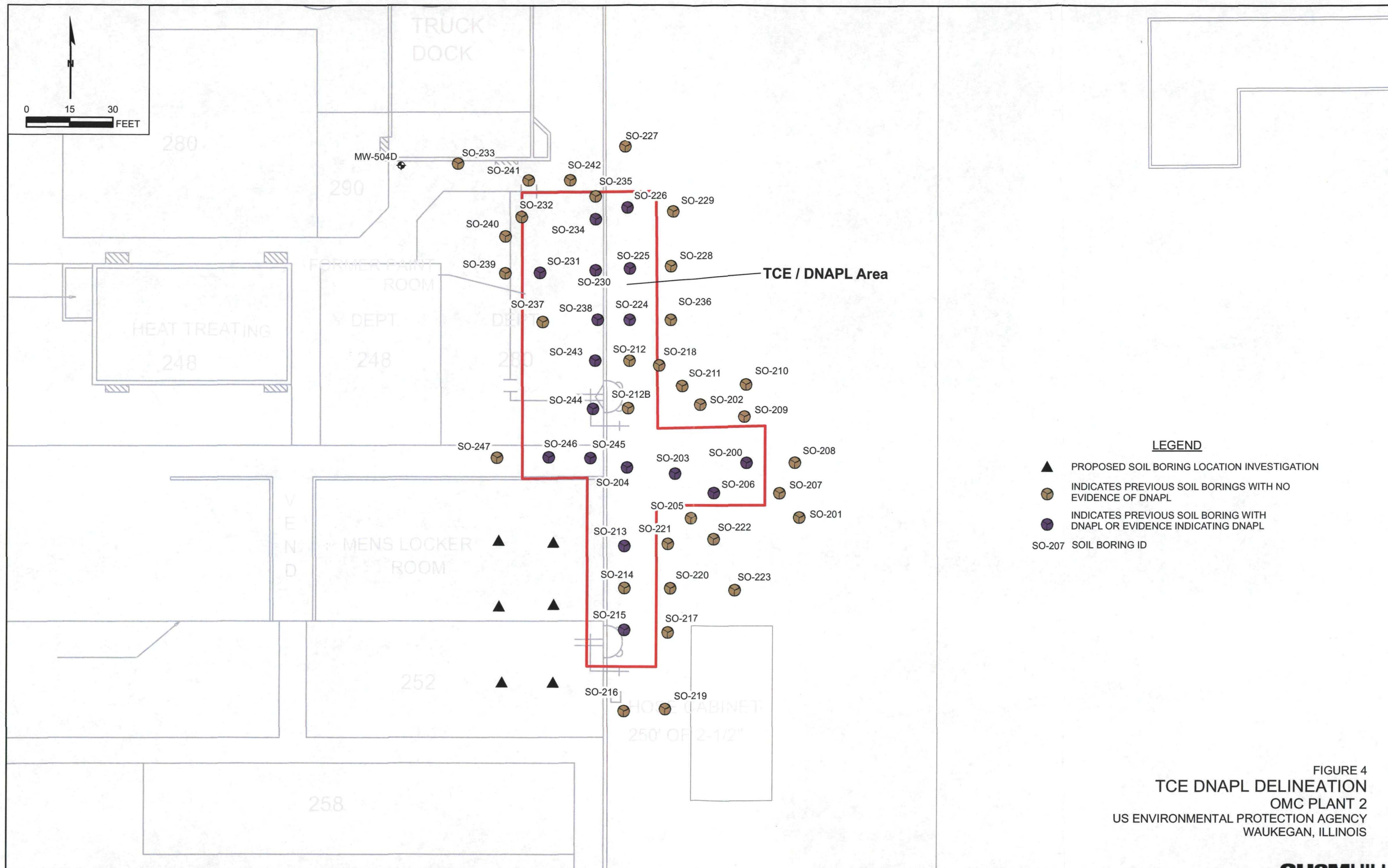
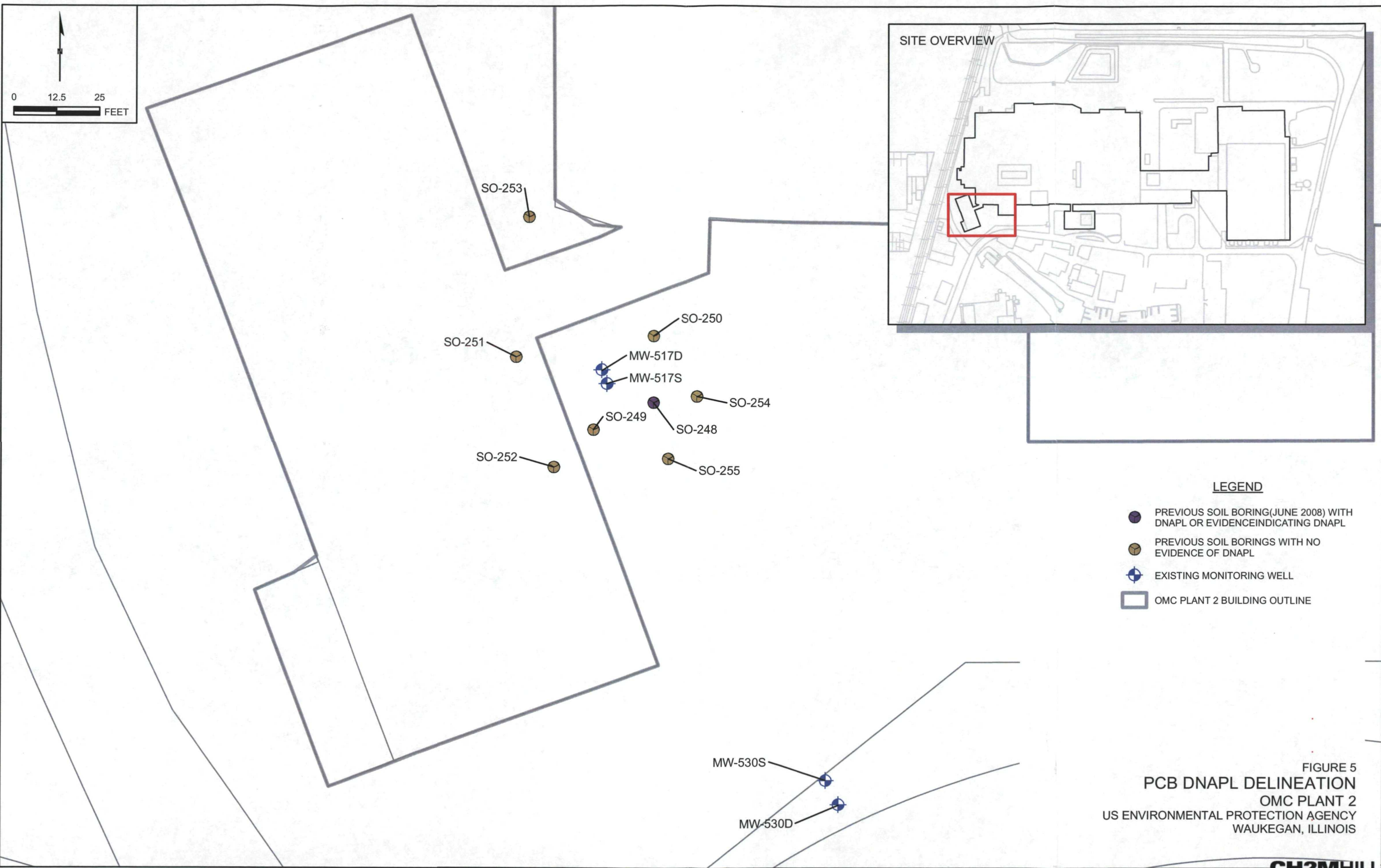


FIGURE 4
TCE DNAPL DELINEATION
OMC PLANT 2
US ENVIRONMENTAL PROTECTION AGENCY
WAUKEGAN, ILLINOIS



Appendix A

Field Operating Procedures

Low-Flow Groundwater Sampling Procedures

I. Purpose

The purpose of this FOP is to describe procedures for collecting groundwater samples using low-flow methods. Methods were developed in accordance with procedures presented in USEPA publications.

II. Scope

This procedure is applicable for monitoring wells that are 1 inch in diameter or greater, and is considered to be appropriate for collections of VOCs, SVOCs, PCBs, and metals. This procedure is not appropriate for the collection of LNAPLs or DNAPLs. Operations manuals should be consulted for specific calibration and operating procedures.

III. Equipment and Materials

The following list presents the equipment needed for low-flow groundwater sampling of organic site-related constituents, as specified in the FSP.

- Electronic water level indicator with an accuracy of 0.01 foot.
- Electronic oil/water interface probe with an accuracy of 0.01 foot.
- Sampling pump with adjustable flow rate. Must be either gear driven, helical driven, air-activated piston, or low-flow centrifugal. An adjustable-rate peristaltic pump can be used when the depth to water is 20 feet or less if the other pump types are not readily available.
- Teflon® or Teflon®-lined polyethylene tubing.
- An appropriate power source for the sampling pump being used.
- A graduated container to determine volume and a watch to monitor flow rate and time.
- YSI® Model 6920 (or comparable) multi-parameter meter with flow-through cell. At a minimum, the meter must be capable of measuring pH, oxidation-reduction potential, dissolved oxygen, turbidity, specific conductance, and temperature.
- Calibration solutions for the multi-parameter meter.
- Decontamination supplies including 10 percent methanol rinse, non-phosphate soap, and distilled water, paper towels, and plastic sheeting.
- Sample bottles and coolers for submittal to the laboratory.
- Field notebook, sample data sheets, chain-of-custody forms, and custody seals.

- Ice.
- Appropriate PPE.
- PID, explosimeter, and oxygen meter (LEL/O₂) and calibration gases, as appropriate.
- Tool box.
- 55-gallon drum or 5-gallon buckets, with covers, to contain purge water.

During the preparation for the field event, the list should be reviewed and modified, as appropriate, to accommodate sample collection of additional analytes or other site-related activities.

IV. Procedures and Guidelines

The following activities shall be completed before the start of purging and sampling:

1. Calibrate the multi-parameter meter, PID, and LEL/O₂ meter. Record all calibration information in the field notebook.
2. Begin sampling at the monitoring well with the lowest concentrations of site-related constituents based on the results of the previous sampling event. Exceptions may be necessary to accommodate site-specific conditions. If no previous groundwater data are available, results of a MIP investigation may be used to determine areas of higher VOCs.
3. Inspect the protective well cover, concrete pad, inner well casing, and locking cap of the monitoring well and record observations in the field notebook. Polyethylene sheeting should be placed on the ground to minimize the potential for sampling equipment to contact the soil. Monitoring, purging, and sampling equipment should be placed on the sheeting.
4. Monitor the headspace of the well with the PID and LEL/O₂ meters immediately after removing the inner casing cap. Readings should be noted in the field notebook. Refer to the site-specific HSP for required actions based on PID and LEL/O₂ readings.
5. Measure the depth to water in the well. Also check the well for nonaqueous-phase liquids using the oil/water interface probe. Total well depth measurement using the oil/water interface probe should not be collected until all samples have been collected to minimize turbidity generated in the well. Measurements will be recorded on sample data sheets and in the field notebook.

V. Purging and Sampling Activities

Procedures for purging and sampling are as follows:

1. Slowly lower the pump and tubing into the monitoring well until the pump intake is set near the midpoint of the screened interval. Record the depth of the pump intake (feet below top of inner well casing) in the field notebook.
2. Remeasure the depth to water and record the information on the sample data sheets. Leave the water level indicator in the well.

3. Place the multi-parameter meter into the flow-through cell. Connect the discharge end of the tubing from the pump to the flow-through cell of the multi-parameter probe. Place the flow-through cell discharge tubing into the 55-gallon drum or a 5-gallon bucket for collection of purge water.
4. Set the flow rate on the pump to the lowest setting, turn the pump on, and slowly increase the flow rate until water begins to flow. Using a graduated cylinder to monitor the flow rate, adjust the pump until a rate of 50 to 500 mL per minute is reached. Maintain a steady flow rate while keeping drawdown to less than 0.33 foot. If drawdown is greater than 0.33 foot, reduce the pumping rate. If a drawdown of less than 0.33 foot cannot be achieved, continue purging and record the groundwater levels and flow rate every 5 minutes.
5. Provided the drawdown does not exceed 0.33 foot (see above), record the discharge rates and drawdown on the sampling data sheets every 5 minutes, and continue purging at a flow rate to minimize drawdown. A minimum of one tubing volume must be purged before recording water quality parameters.
6. After a minimum of one tubing volume has been purged, record the values of the water quality parameters. After the initial measurement, record the water quality parameter readings concurrently with the discharge rate and drawdown measurements.
7. Continue purging until three successive readings of the water quality field parameters stabilize, following the criteria in Table 1, below. When the water quality parameters stabilize, collect the samples.

TABLE 1

Stabilization Criteria with References for Water-Quality-Indicator Parameters

Parameter		Stabilization Criteria
pH		± 0.1
Specific Electrical Conductance		$\pm 3\%$
Oxidation-Reduction Potential		± 10 millivolts
Turbidity		$\pm 10\%$ (when turbidity > 10 nephelometric turbidity units)
Dissolved Oxygen		± 0.3 milligrams per liter

Source: USEPA 2002.

8. If a stabilized drawdown in the well cannot be maintained at less than 0.33 foot and the water level is approaching the top of the well screen, reduce the flow rate or turn the pump off for 15 minutes and allow for recovery. The pump should not be turned off if it does not have a check valve installed inline with the tubing to prevent water flowing out of the tubing into the well. If the pump must be turned off and no check valve is present, the discharge end of the tubing should be clamped to minimize the potential for water to flow back into the well. After 15 minutes, resume pumping, at a lower rate, if possible. If water levels again approach the top of the well screen, turn the pump off and allow another 15 minutes for recovery. If two tubing volumes have been removed (including the volume in the flow-through cell and tubing), collect a sample when the pump is

turned on. Record this information in the field notebook so that adjustments can be made for the next sampling event.

9. For collection of samples, pumping rates should be maintained to minimize disturbance of the water column. The discharge tubing should be disconnected from the input of the flow-through cell and samples collected directly from the pump discharge tubing. Sample bottles for VOCs and/or dissolved gasses should always be filled first.
10. Upon sample collection, remove the pump from the well, decontaminate the pump, and dispose of the tubing, if it is not dedicated.

VI. Attachments

- Low-Flow Well Sampling: Field Data Sheet.
- USEPA. May 2002. *Groundwater Sampling Guidelines for Superfund and RCRA Project Managers*. Groundwater Forum Issue Paper, Technology Innovation Office; Office of Solid Waste and Emergency Response. EPA 542-S-02-001.

VII. Key Checks and Items

None.

Low - Flow Well Sampling: Field Data Sheet

[illegible]

Measuring Monitoring Well Wellhead Pressures

I. Purpose and Scope

This field operating procedure (FOP) provides guidelines for measuring pressures accumulating in monitoring wells as a result of air sparge operations.

II. Equipment and Materials

- Threaded Schedule 40 PVC plug of same diameter as the monitoring well equipped with the following (installed and dedicated at the monitoring well):
 - Ball valve: 1/4-inch female pipe thread fittings
 - Pipe nipple: 1/4-inch diameter x 1-inch long galvanized steel
 - Barbed hose adaptor: 1/4-inch male pipe thread by 1/4-inch barb 90-degree elbow
- Schedule 40 PVC slip by threaded adaptor of same diameter as the monitoring well (installed and dedicated at the monitoring well)
- Well keys and wrenches
- Clean latex or nitrile gloves
- Length of silicon tubing
- 0-15 psi glycerin-filled pressure gauge with a brass male fitting on the bottom (McMaster Carr Part No. 3715K201 or similar)
- Field logbook

III. Procedures and Guidelines for Wellhead Completion

- Secure a Schedule 40 PVC slip by threaded adaptor to the wellhead (NOTE: THIS WILL CHANGE THE TOP OF CASING ELEVATION OF THE WELL). The well casing may need to be cut down to fit the adaptor and modified well cap in the well vault. Use preventative measures to keep materials from falling in the well during the retrofit (i.e. shove a rag in the well and carefully remove).
- Drill and tap a 1/4-inch diameter hole in the center of the PVC plug. To ensure a secure fit, do not overdrill the hole.
- Wrap the ends of the 1/4-inch diameter galvanized steel nipple and barbed adaptor with Teflon tape

- Thread the nipple and barbed adaptor into the brass ball valve. Thread such that the handle on the ball valve turns up to open the valve.
- Thread the nipple, ball valve, and barbed adaptor assembly into the PVC plug
- Thread the plug onto the PVC adaptor secured to the monitoring well wellhead
- Make sure the ball valve is closed

IV. Procedures for Measuring Wellhead Pressure

- Open the well protector
- Document any observed air leaking from the wellhead
- Secure one end of the silicon tubing to the barbed fitting on the wellhead and the other end to the pressure gauge
- Open the ball valve on the wellhead
- Document the pressure in the field logbook
- Close the ball valve on the wellhead
- Remove the silicon tubing from the barbed fitting

V. Key Checks

- Do not open a monitoring well if it is under pressure. Bleed off the pressure first by opening the ball valve and allowing the pressure to dissipate. If the pressure does not dissipate within one hour, contact the task or project manager.

VI. Attachments

Photograph of sample wellhead completion prior to securing to wellhead.



ISSM QA/QC and Baseline Soil Sampling

I. Purpose

These general outlines describe the collection and handling of QA/QC and baseline soil samples during ISSM construction activities.

II. Scope

The purpose of this Field Operating Procedure (FOP) is to define protocols for the collection of QA/QC and baseline soil samples during soil mixing activities.

Soil samples will be collected per the frequencies indicated in the Field Sampling Plan (FSP) and analyzed for iron content in the field in accordance with the associated FOP.

Additionally, soil samples will be collected per the frequencies indicated in the Field Sampling Plan (FSP) and analyzed for VOCs to establish baseline conditions immediately following mixing activities. These samples should additionally follow the FOP for VOC soil sample collection.

III. Equipment and Materials

- Provided by Subcontractor
 - Excavation equipment with bucket or similar collection device determined by subcontractor
- Health and Safety
 - Personal protection equipment (nitrile gloves, boots, etc.)
- Decontamination
 - Decontamination solutions (as specified in FOP)
 - Brushes and containment basins
- Sampling (as appropriate)
 - Sample collection device (decontaminated stainless steel scoop or a disposable sampler)
 - Stainless steel spoon or spatula for media transfer
 - Log book
 - Sample bottles
- Sample Packing – Per FOP

IV. Procedures and Guidelines

- The subcontractor is responsible for identifying means, methods, and equipment necessary to provide requested samples at specified discrete depths.

- With the equipment in position at the sample location, record sample description, depth, time, and date of sampling in the field logbook. Include reference to mixing column number per the subcontractor's Soil Mixing Plan to identify approximate location of sample.
- Soil samples will be collected at 1 foot from the bottom, the middle, and the top of the mixing column at the first location each day during Week 1. They will be collected at 1 foot from the bottom and the middle at the second location each day during Week 1. During all weeks after Week 1, soil samples will be collected at 1 foot from the bottom and the middle from one location per day. These samples will be analyzed in the field for iron content in accordance with the FOP.
- During collection of QA/QC discrete samples, additional samples will be collected at a frequency of 1/1000 cubic yards of mixed soil for VOC analysis to establish baseline soil conditions immediately following mixing.
- Decontaminate media transfer tools before using to collect another sample. Refer to the *Field Sampling Equipment Decontamination* FOP.
- Record sample description, depth, time, and date of sampling in the field logbook.
- Fill out the chain-of-custody form.
- Quality control samples that are collected with soil samples will be identified in accordance with procedures outlined in the FSP.

V. Attachments

None.

VI. Key Checks and Items

- Make sure the soils are kept at a temperature of 4 degrees Celsius.
- Determine whether a QC sample will be required at a sampling location. If a QC MS/MSD or duplicate soil sample will be needed, then additional sample volume will be required.
- Ensure that all tools that may come into contact with the sample, a team member, other equipment, or uncontaminated environment are properly decontaminated.
- Collect rinse water investigation-derived waste from decontamination activities.

Soil Mixing Iron Content Analysis Method

I. Purpose

The purpose of this FOP is to present the protocols for extracting zero-valent iron (ZVI) from soil treated using in-situ soil mixing with bentonite clay and ZVI.

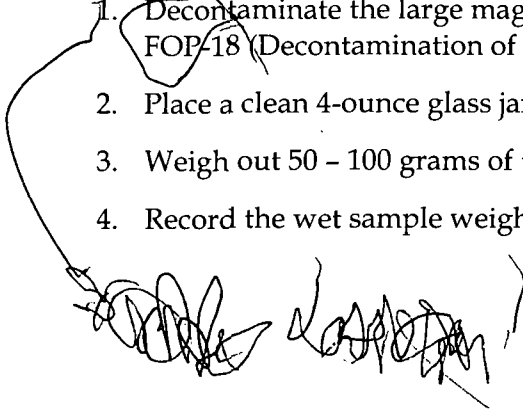
II. Scope

The method described for iron extraction is applicable for soils treated by incorporating bentonite clay and ZVI.

III. Equipment and Materials

- 4 to 8 ounces of treated soil
- Two clean, unpreserved, 4-ounce glass jars
- Small ferrous iron pan
- Small oven (toaster oven or equivalent capable of holding small ferrous iron pan)
- Digital scale capable of measuring to 0.1 grams
- 2 small disposable plastic spoons
- Distilled water
- Paper towels
- Wax paper
- Spray bottle
- Large magnet (e.g., 6-inch speaker magnet)
- Plastic food wrap
- Pencil
- Field logbook and camera
- 5-gallon bucket
- Decontamination supplies
- Protective equipment, including heat-resistant outer gloves, nitrile gloves, safety glasses, and dust mask (Note: See HSP for specific PPE required for the sampling activities.)

IV. Procedures and Guidelines

1. Decontaminate the large magnet and ferrous iron pan using the methods specified in FOP-18 (Decontamination of personnel and equipment):
 2. Place a clean 4-ounce glass jar on the digital scale and press tare.
 3. Weigh out 50 - 100 grams of treated soil into the jar.
 4. Record the wet sample weight of the soil in the field notebook.
- 

5. Transfer the soil onto the decontaminated ferrous iron pan and place the pan into the oven on low to moderate heat until the soil is complete dry. **Do not leave oven unattended while operating.**
6. Place a clean 4-ounce glass jar on the digital scale and press tare.
7. After soil is completely dry carefully transfer the dried soil into the clean 4-ounce jar.
8. Record dry sample weight in the field notebook.
9. Calculate iron concentration by placing a clean, unpreserved, 4-ounce glass jar on digital scale and tare.
10. Carefully weigh out 50 – 100 grams of treated soil into the clean, unpreserved, 4-ounce glass jar and record soil weight in field notebook.
11. Transfer the soil onto the decontaminated ferrous iron pan.
12. Fill spray bottle with distilled water.
13. Carefully wet and agitate soil in pan to suspend fine-grained soil and clay in water.
14. Decant rinse water with suspended fine-grained material into 5-gallon bucket **while retaining iron and coarse soil (sand) particles.** Repeat steps 13 and 14 twice.
15. Place the large magnet on the **underside** of the pan.
16. Add more water and slowly move slurry across the magnet to allow iron particles to accumulate in the pan directly above the magnet.
17. Transfer rinse water, iron, and soil (this is the "iron sand concentrate") that have not accumulated above the magnet into a clean container.
18. Remove iron that has accumulated above the magnet and place into a clean, 4-ounce glass jar.
19. Return the "iron sand concentrate" to the pan and repeat steps 16 through 18 until the remaining sand is visibly free of iron particles.
20. Remove large magnet from the base of the pan.
21. Place pan with iron in the oven on low to medium heat until the iron is dry.
22. Turn off heat and allow pan to cool.
23. To remove any remaining sand, spread the dried iron thinly on a clean piece of wax paper.
24. Cut one piece of plastic wrap large enough to cover the magnet
25. Weigh the two pieces of plastic wrap on the scale and record the weight in the field notebook. Wrap the magnet in the plastic wrap.
26. Collect iron particles by passing the magnet over the material on the wax paper. Care should be taken not to pick up soil particles with the magnet.

27. Carefully remove the plastic wrap from the magnet, fold the plastic wrap to contain the iron, and weight the plastic wrap and iron.
28. Subtract the weight of the plastic wrap from the iron – plastic wrap combination.
29. Calculate the iron fraction per dry weight soil using the following formula:

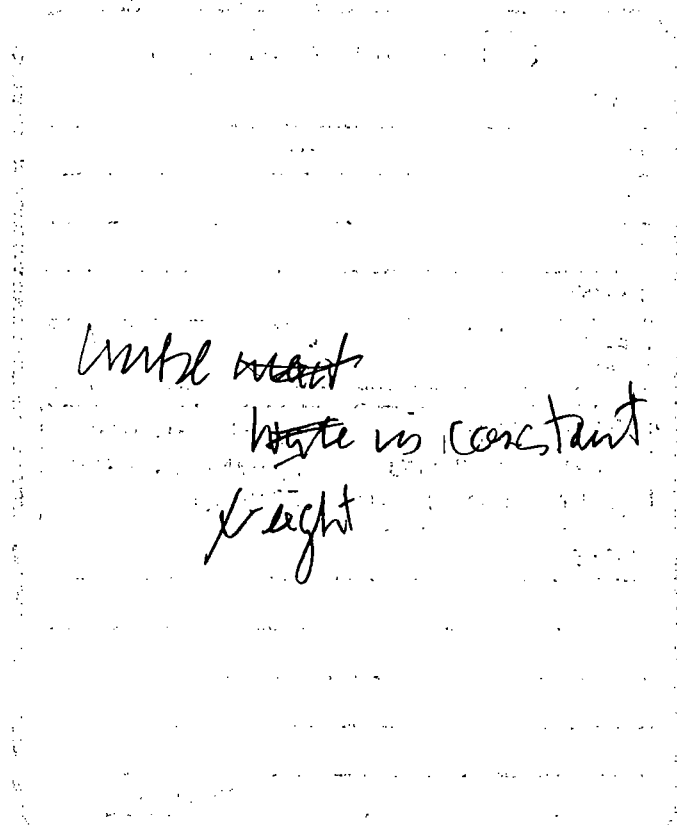
$$\%Iron = \frac{WeightExtractedIron}{InitialSampleWeight} \frac{DrySampleWeight}{WetSampleWeight} * 100$$

V. Attachments

None.

VI. Key Checks and Items

- Ensure consistent application of the procedure between sampling locations
- Consider preparation of a known concentration standard to determine potential margin of error.
- Run standard mixture multiple times to optimize process layout.



Volatile Organic Compound Soil Sampling

I. Purpose and Scope

The purpose of this FOP is to provide a general guideline for the collection of volatile organic compound (VOC) soil samples using OLM04.3 or SW-846 Methods 1311 and 8260B sampling methods.

II. Equipment and Materials

- Disposable syringe-type coring device, or En Core[®]-type samplers and En Core-type T-handle
- Decontamination supplies, including 10 percent methanol rinse, nonphosphate soap, and distilled water, paper towels, mixing bowls and spoons, and aluminum foil
- Sample bottles and cooler for submittal to the laboratory
- Field notebook, sample data sheets, chain-of-custody forms, and custody seals
- Ice
- Clean latex or surgical style chemical-resistant gloves and additional appropriate personal protective equipment
- PID, explosimeter, and oxygen meter (LEL/O₂) and calibration gases, as appropriate
- Tool box
- 55-gallon drum or 5-gallon buckets, with covers, to contain investigation-derived wastes

During the preparation for the field event, the list should be reviewed and modified, as appropriate, to accommodate sample collection of additional analytes or other site-related activities.

III. Procedures and Guidelines

This technique provides for the handling of intact soil cores, the preservation options of those soil cores in hermetically sealed containers, and the minimization of analyte loss because of direct volatilization and biodegradation. ~~If hermetically sealed containers are not used for VOC sample collection, every effort should be made to minimize volatilization between the collection of the sample aliquot using a sampling tool (e.g. stainless steel trowel or spoon) and the insertion of the sample material into the required sample container.~~

IV. Use of En Core-type Hermetically Sealed Containers

Three En Core-type samplers are collected to suffice for volume/analysis of one sample. Two aliquots are needed for low-level analysis and reanalysis, if necessary. One aliquot is needed for extraction in methanol by the laboratory in the case where high-concentration target analytes are indicated during low-level analysis. Exposure to the air must be minimized by obtaining the soil subsample directly from the sample source (i.e., steel sleeve, wide-mouth jar, etc.) using the En Core sampler.

VOC samples will be placed in a cooler containing enough ice to maintain an internal air temperature of 4°C. Samples will be shipped the same day as collection. The field team will ship the samples by overnight express delivery. The 4°C temperature in the cooler must be maintained throughout its route to the laboratory. Samples must be analyzed within 48 hours of collection if not frozen/preserved by the laboratory. The laboratory may freeze/preserve the samples (if done so within 48 hours of sample collection time) to extend the holding time to 7 days, if frozen, and 14 days, if preserved in bisulfate solution or methanol. If no other analyses are being performed, a 2-oz jar of soil must also be collected to analyze for percent moisture.

V. Attachments

None.

VI. Key Checks and Items

Check that samples are immediately stored and remain at 4°C minimum.

Check that the drilling operator thoroughly completes the decontamination process between sampling locations.

Direct Push Soil Sample Collection

I. Purpose

The purpose of this FOP is to provide a general guideline for the collection of soil samples using direct push (e.g., GeoProbe®) sampling methods.

II. Scope

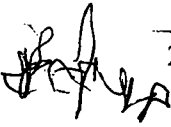

The method described for direct push soil sampling is applicable for soil sampling at and below the ground surface and groundwater grab samples at discrete intervals within the saturated zone. Specific equipment and responsibilities of direct push subcontractors are described in contracting documentation.

III. Equipment and Materials

- Truck-mounted hydraulic percussion hammer
- Sampling rods
- Sampling tubes and liners (for soil samples)
- Photoionization detector or flame ionization detector
- CGI
- Double hook-bladed knife or other tool for opening liners
- Clean latex or surgical gloves as specified in the Health and Safety Plan
- Precleaned sample containers, stainless steel sampling equipment, coolers and other sampling supplies as referred to in the Field Sampling Plan
- Decontamination supplies including 10 percent methanol rinse, nonphosphate soap, and distilled water, paper towels, and plastic sheeting.
- Field notebook, sample data sheets, chain-of-custody forms, and custody seals
- Ice
- Appropriate personal protective equipment
- Tool box
- 55-gallon drum or 5-gallon buckets, with covers, to contain soil and purge water.

IV. Procedures and Guidelines

Soil Sampling

- 
- 
1. Ensure sampling tubes and other nondedicated downhole equipment and sampling equipment are decontaminated in accordance with the FOP.
 2. Wear appropriate personal protective equipment, as required by the Health and Safety Plan. Change gloves between sampling locations.
 3. Confirm all underground utility clearances have been obtained and maps of private utilities have been consulted.
 4. Drive sampling tube to the desired sampling depth using the truck-mounted hydraulic percussion hammer. If soil above the desired depth is not to be sampled, first drive the lead rod, without a sampling tube, to the top of the desired depth.
 5. Remove the rods and sampling tube from the borehole and, using the double hook-bladed knife or other tool, carefully split the liner to allow access for removing the sample from the tube.
 6. Conduct photoionization detector readings at soil intervals as agreed by the field technician and field team leader, and record the data. At least one photoionization detector reading should be taken on each explicitly logged soil interval. Log the soil sample according to visual methods outlined in ASTM Method D 2487-98.
 7. Fill all sample containers using decontaminated sampling equipment, beginning with the containers for VOC analysis. (See FOP , *Volatile Organic Compound Soil Sample Collection*.) Soil samples for inorganic and nonvolatile organic analyses will be separated and transferred into stainless steel bowls, homogenized by mixing with a stainless steel spoon, and transferred to the appropriate sample container. Remove large pebbles and cobbles from sample before placing in jars.
 8. Label, handle, and store the sample according to the associated FOPs for Documentation and Chain of Custody and Sample Handling, Packaging, and Shipment. Discard unused sample according to the guidelines for investigation-derived waste as outlined in the Site Management Plan.
 9. Decontaminate all nondedicated downhole equipment (rods, sampling tubes, etc.) in accordance with the FOP.
 10. Additional sampling may be required at the location. The location should be secured and clearly marked to prevent slip/trip/fall injuries. Abandonment should only be performed after discussions with the field team leader and project team.

V. Attachments

None.

VI. Reference

ASTM Method D 2487-98.

VII. Key Checks and Items

1. Verify that the hydraulic percussion hammer is clean and in proper working order.
2. Monitor that the direct push operator thoroughly completes the decontamination process between sampling locations.
3. Determine if a QC sample will be required at a sampling location (refer to the Field Sampling Plan). If additional sample volume is required, another direct push advancement to the same depth interval may be needed.
4. Collect rinse water investigation-derived waste and containerize with well development and purge water.
5. Verify that the borehole made during sampling activities has been properly backfilled and the surface restored.

Sample Handling, Packaging, and Shipment

I. Purpose

The purpose of this FOP is to describe the handling, packaging and shipment of environmental samples.

II. Sample Packaging

Sample packaging and shipping procedures are designed to ensure that the samples will arrive at the laboratory, along with the COC, intact. Whenever possible, sample tags and COC forms will be produced by the most recent version of the software *Forms II Lite ver. 5.1* per FOP#6. Samples will be packaged for shipment as outlined below:

- All sample containers will have affixed sample tags.
- Caps on the sample containers will be checked to ensure they are properly sealed.
- COC forms will be completed with required sampling information, and recorded information will match the sample tags.
- If the designated sampler relinquishes samples to other sampling or field crew member for packing or other purposes, the sampler will complete the COC prior to this transfer.
- Appropriate personnel will sign and date COCs to document the sample custody transfer.
- The outside drain plug at the bottom of the cooler will be secured inside and out using duct tape.
- Sample containers will be protected in bubble wrap or other cushioning material. 1 to 2 inches of cushioning material will be placed at the bottom of the cooler. Vermiculite will not be used as a cushioning material in accordance with the August 31, 2000 memo from the USEPA Regional Safety Manager, which suspended the use of this material for sample packaging.
- Sealed sample containers will be placed in the cooler.
- Ice will be double bagged with plastic zipper bags. Bags will be sealed and placed loosely in the cooler. Remaining space in the cooler will be filled with cushioning material.
- COC forms will be placed in a sealed plastic bag and taped to the inside of the cooler lid.
- Temperature blanks will accompany all samples transported to the laboratory.
- The lid of the cooler will be closed, locked, and secured with tape. Strapping tape will be wrapped around both ends of the cooler at least twice.
- The cooler will be marked on the outside with the following information: shipping address, return address, "fragile" labels, and arrows indicating "this side up."

- Labels will be covered with clear plastic tape.
- USEPA Region V custody seals will be placed over opposite corners of the cooler lid and covered with clear plastic tape.
- All coolers will be shipped or sent by courier with the samples to the analytical laboratory(s) by express overnight service or courier service.
- All samples will be transported or shipped in a manner that protects integrity of the samples and safety of the handlers.
- Original COC forms will accompany the shipment; copies will be retained by the sampler for sampling records.
- If samples are sent by common carrier, bills of lading will be used. Receipts or bills of lading will be retained as part of the permanent project documentation.
- Commercial carriers will not be required to sign off on COC forms as long as the forms are sealed inside the sample cooler and the custody seals remain intact.
- Packaging, marking, labeling, and shipping of samples will comply with the regulations promulgated by the U.S. Department of Transportation in the Code of Federal Regulations (49 CFR 171-177).
- Field samples will be analyzed as soon as possible after receipt at the laboratory.

III. Shipping

If samples are shipped by commercial carrier, customer copies of airbills will be retained to provide a record for sample shipment to the laboratory. Completed airbills will accompany shipped samples to the laboratory and will be forwarded along with data packages. The airbill number will be documented on the COC accompanying the samples to the laboratory for sample tracking purposes. Airbills will be kept as part of the data packages in the project files.

IV. Attachments

None.

Documentation/Chain-of-Custody Procedure

I. Purpose

The purpose of this FOP is to provide a definition of "custody" and describe protocols for documenting the transfer of custody from one party to the next (e.g., from the site to the laboratory). A documented custody trail is established through the use of sample tags and a USEPA chain-of-custody form which uniquely identifies each sample container, and who has possession of it from the sample's origin to its final destination. The chain-of-custody form also describes the sampling point, date, time, and analysis parameters.

II. Scope

Sample personnel should be aware that a sample is considered to be in a person's custody if the sample meets the following conditions:

- It is in a person's actual possession
- It is in view after being in a person's possession
- It is locked up so that no one can tamper with it after having been in physical custody

When samples leave the custody of the sampler, the cooler must be custody-sealed and possession must be documented.

Data generated from the use of this FOP may be used to support the following activities: site characterization, risk assessment, and evaluation of remedial alternatives.

III. Equipment and Materials

- Computer with Forms II Lite software loaded
- Printer with paper (8.5- × 11-inch) and ink cartridge (black or color)
- USEPA Region 5 Sample Tag
- Forms II Lite generated tag label (encouraged, but not mandatory)
- Indelible black ink pen

IV. Procedures and Guidelines

Chain-of-Custody Forms

The chain of custody form must contain the following information:

- CASE NUMBER/CLIENT NUMBER: If a CLP laboratory is used, enter the case number provided by EPA's RSCC. If the CLP is not used, enter the SAS number provided by CH2M HILL's Sample and Analytical Coordinator.
- USEPA REGION: Enter Region "5."
- CERCLIS ID: For OMC, use "ILD000802827."

- SPILL ID: For OMC, use "0528."
- SITE NAME/STATE: For OMC, this will be "OMC PLANT 2", "IL."
- PROJECT LEADER: Enter the CH2M HILL Site Manager.
- ACTION: For OMC, choose "Remedial Action."
- SAMPLING CO.: "CH2M HILL."
- SAMPLE NO.: This is the unique number that will be used for sample tracking. For CLP, this number is taken from a block of numbers assigned by the EPA RSCC. For non-CLP, the CH2M HILL Sample and Analytical Coordinator will assign this number.
- MATRIX: Describes the sample media (e.g. groundwater, soil, etc.).
- SAMPLER NAME: The name of the sampler or sample team leader.
- CONCENTRATION: Low (L), Low/Medium (M) or High (H).
- SAMPLE TYPE: "Grab" or "Composite."
- ANALYSIS: This indicates the analyses required for each sample.
- TAG NO.: This number appears on the bottom of the sample tag and includes a prefix ("5") followed by a series of numbers. The entire number must appear on the chain-of-custody form.
- PRESERVATIVE: Document what preservative has been added to the sample (e.g. "HCl," "ice only," "none").
- STATION LOCATION: This is the CH2M HILL Station Location Identifier.
- SAMPLE COLLECT DATE/TIME: Use military time.
- QC TYPE: This is for field QC only, and includes field duplicate, field blanks, equipment blanks, and trip blanks.
- DATE SHIPPED: The date that samples are relinquished to the shipping carrier.
- CARRIER NAME: (e.g., "FedEx").
- AIRBILL: Airbill number used for shipping. (If samples are hand delivered to their destination, "hand delivered" should appear in this field.)
- SHIPPED TO: This is the laboratory name and full address, including the laboratory contact. If the contact is not known, use "Sample Custodian."
- CHAIN OF CUSTODY RECORD fields: This sampler's signature must appear in the "Sampler Signature" and the "Relinquished By" fields. The date and time (military time) must also be included. If additional personnel were involved in sampling, their signatures should appear in the "Additional Sampler Signature(s)" field.

Although the samples are "relinquished" to the shipping carrier, the shipping carrier does not have access to the samples as long as the shipping cooler is custody sealed. Consequently, the shipping carrier does not sign the chain-of-custody form.

- **SAMPLE(S) TO BE USED FOR LABORATORY QC:** This identifies which samples are to be used for matrix spike/matrix spike duplicate analyses.
- **Indicate if shipment for case is complete:** Use "Y" or "N."
- **CHAIN-OF-CUSTODY SEAL NUMBER:** Record the custody seal numbers that appear on the Region 5 custody seals that can be found on the shipping container. There is usually a minimum of two per shipping container.

Sample Tags

Each sample container will be identified with a uniquely numbered sample tag issued by USEPA Region 5. Each tag will contain the following information:

- Case/SAS number
- The unique sample number for sample tracking
- CH2M HILL station location (i.e., the sample identifier)
- Date of sampling
- Time the sample was collected (in military time)
- All parameters for which the sample will be analyzed
- Preservative used (if any)
- Sample type (grab or composite)
- Sample concentration (low, medium, high)
- Sample matrix (groundwater, soil, air, etc.)
- The signature of sample team leader
- Identification when sample is intended to be used by the lab for matrix spike/spike duplicate

V. Attachments

- Attachment 1: Forms II Lite Quick Reference Guide
- Attachment 2: Chain-of-Custody Form, Sample Tag, Custody Seal

VI. Key Checks and Items

- All sample containers must be properly tagged.
- Each cooler must have a chain-of-custody form and the samples in the cooler (as identified by the sample tags) must match what is on the chain-of-custody form.
- Each chain-of-custody form must be properly relinquished (signature, date, time).
- The custody seal numbers must be written on each chain-of-custody form.
- The shipping cooler must be custody sealed in at least two places.

VII. FOP-6, Attachment 1

Forms II Lite Quick Reference Guide

Getting Started

- (a) Click on the **Start** button on the Windows Desktop and select **Programs**. Select **Forms II Lite** and click on the FORMS II Lite item. The FORMS II Lite application will begin.
- (b) Click **File** on the Main Menu bar. Click on the **New Site** item. The first data entry screen will appear.

Step 1 – Enter Site Information

- a) Enter all relevant information necessary for Chain-of-Custody paperwork (in accordance with Regional guidance). For CLP Traffic Reports (TRs) this includes:
 - Site Name
 - State
 - EPA Region Number
 - CLP Case Number
 - Lead Sampler
- b) Click the **Next** button to proceed to Step 2.

Step 2 – Select Sampling Team

- a) Select sampling team members from the **Unassigned Team Members** window by clicking on each name.
- b) Click the **>** button. The selected name will move to the **SelectedTeam** window. Repeat until all team members for this sampling event are selected.
- c) Click the **Add/Edit Team Members** button to add any remaining sampling team members names that do not appear in the **Unassigned Team Members** window.
- d) Enter the first and last name of each sampler. If you would like to add the sampler to the permanent list, click the **Add to Permanent List** box. After you have entered the samplers' names, click the **OK** button. These samplers will appear in the **Selected Team Members** window on the Select Sampling Team screen.
- e) Click the **Next** button to proceed to Step 3.

Step 3 – Select Analysis

- a) Select an analysis from the **Available Analyses** window by clicking on the analysis.
- b) Click the **>** button. The selected analysis will move to the **Selected Analyses** window. Repeat until all analyses to be performed on samples collected for this sampling event are selected.
- c) To edit Turnaround Time, click the **Edit Turnaround Days** button. The **Edit Project and Turnaround** screen will appear.

- d) Click on the **Turnaround Time** drop down menu to select the number of days or type in a value. Click **Close** to close screen.
- e) Click the **Next** button to proceed to Step 4.

Step 4 – Enter Station

- a) Enter all relevant information necessary for Chain-of-Custody paperwork (in accordance with Regional guidance). For CLP TRs this includes:
 - Station Name and Location
 - Sample Matrix
 - Sample Date/Time
 - Sample Type
 - Sampler Name
- b) The Sample Date/Time field is strictly military time. You may click on the System Date/Time checkbox to populate the current system date/time value into the sample date/time.
- c) Click the **Add Station** button to enter the name of a new station and continue with the station locations. To enter a new station location associated with a previously entered station, click on the station name, then click the **Add Location** button, and enter the name of the new station location.
- d) Click the **Next** button to proceed to Step 5.

Step 5 – Assign Bottles and Samples

- a) Select the Station Location from the **Station/Location** window.
- b) Select the analyses associated with the containers from the **Analysis** window. If more than one analysis is associated with a container, select the additional analysis(es) by holding down the control key, and clicking on the additional analysis(es).
- c) Enter the number of bottles that will be assigned a specific analysis or set of analyses.
- d) Enter the sample tag prefix and starting tag number. Click **Auto Increment Tag Number** if you wish to assign sequential tag numbers for your sampling event. Sample numbers are automatically and sequentially assigned for your sampling event and are unique per Station Location.
- e) By default CLP sample numbers are automatically used for CLP analyses. Note that FORMS II Lite generates CLP sample numbers using a BASE 32 system which differs from the CLASS generated CLP sample numbers.
- f) Edit the sample number and other pertinent information for these samples in the space provided. After you have confirmed your entries, click the down arrow.
- g) Repeat steps 5b through 5f until all desired analyses have been assigned to bottles.
- h) Click the **Next** button to proceed to Step 6.

Generate Labels

- a) Click the **Generate Labels** button in Step 5. The application automatically displays samples for the current Station Location. These are the samples for which labels will be generated. Click the appropriate checkbox at the bottom of the screen to select all samples for the station or site. Enter the number of labels to print next to each record if you need more than one.
- b) Click the **Generate Labels** button and select the appropriate label template to view, then click **OK**. Edit an existing template by clicking the **Edit Label** button. If you wish to add a new label template, click the **Add New Label** button and follow the wizard to create a new template. Enter the number of blank labels to control printing on a label other than the first one on the page.
- c) View the labels at the end of the edit label or new label process. If labels are not acceptable, close the view and edit the label template. If the labels are acceptable, print the labels.
- d) Select **File** and then **Print** from the Main Menu bar. Select the desired number of copies to be printed and click the **OK** button to print the labels. Click **Close** to return to Step 5.

Step 6 - Select Samples and Assign Lab

- a) Select a laboratory from the **Lab Code** drop down menu. If the laboratory where samples will be shipped does not appear in the list, click the **Add Lab** button and add the lab information.
- b) Select samples from the **Unassigned Samples** window by holding down the [Ctrl] key and clicking on each sample that will be shipped to this laboratory. After you have selected all the samples for the laboratory, click the down arrow.
- c) Repeat steps 6a and 6b until all samples have been assigned to laboratories.
- d) Click the **Next** button to proceed to Step 7.

Step 7 - Select Labs and Assign Shipping

- a) Enter the carrier, date of shipment and airbill number.
- b) Select samples from the **Unassigned** window by holding down the [Ctrl] key and clicking on each sample that will be shipped using this airbill. After you have selected the samples to be shipped, click the down arrow.
- c) Repeat steps 7a and 7b until all samples have been assigned airbill numbers.
- d) Click the **Finish** button for system generated TRs. FORMS II Lite will then display a screen that enables you to view and print TRs for the site.
- e) Click **Next** and proceed to Step 8 to customize TRs for specific sets of samples.

Step 8 - Customize Traffic Report

- a) Confirm the last four digits of the TR number. (The first two digits represent the Region number, the next nine digits are a random number and the next six digits are the date

the TR was created, and the last four digits are automatically incremented by the system but may be edited by the user.)

- b) Select a shipment from the **Shipping** window. Select the samples from the **Samples** window that will be assigned to this TR. After you have selected the samples, click the down arrow. (NOTE: samples must be of the same program type and must have the same project code to be assigned to a single TR.)
- c) Repeat steps 8a and 8b until all samples have been assigned.
- d) Click the **Finish** button. FORMS II Lite will display a screen that will enable you to view, print, archive and export TRs. Follow the directions to print the TRs.

Quick Edit

- a) On the **View/Print TR** screen displayed after completion of Step 8, click the **Quick Edit** button.
- b) The user may edit most data fields, except those in red, prior to printing a TR. Also able to sort and filter any column and print a report.

Helpful Hints to Use FORMS II Lite 4.0

This Quick Reference Guide is designed to help FORMS II Lite users enter information for their sampling events and generate bottle labels and Chain-of-Custody paperwork. FORMS II Lite provides users the flexibility to enter most of their information ahead of the sampling event.

FORMS II Lite allows users to:

- Add values that are not included in the "list and pick" menus: Select **Admin** from the Main Menu bar, enter the password to log in. **Admin** now shows the user as being (**logged in**). Select **Reference Tables**, and choose the table that requires editing.
- Customize screens and disable non-key fields: While logged into **Admin** on the Main Menu Bar, select **Custom Features** and click on **Field Names**. Field names and non-key fields can be renamed or hidden on the screen.
- Review the data entered throughout the data entry process by clicking on the **Quick View** button in Steps 4 through 8.
- Select multiple items by highlighting the first item, then hold down the [Ctrl] key and click on the additional items. Or simply click and drag to highlight multiple items.
- Sort data displayed in windows by clicking on the column label. Click on a second column label for a secondary sort.
- Specify more than one sampler's name for samples collected at a
- specific station location. In Step 4, select a sampler's name, then click within the data entry field after the name. Type a comma and type in the second name.
- Export Site information as either a text or (.dbf) file.

- **Note:** FORMS II Lite will not allow information that has been typed over to be saved as a separate file. Once a value in a field has been replaced (edited) with a new value, the original value is lost.

User Preferences

- The following features are maintained in **User Preferences** under **Admin** on the Main Menu bar and can be turned on or off.
- Select **Copy Station** to make the button available in Step 4 to duplicate the current station and its station location information. **Copy Location** duplicates station locations.
- Select the option **Use Default Number of Bottles**, set in the Analysis Reference Tables, to populate the number of containers for each analysis in Step 5.
- Select **Assign All** to make the button available in Step 5 to assign each of the analyses to a separate container. Set the number of containers for each analysis in the bottles field or define through User Preferences.
- Select **One-Step Printing** to make this button available in Step 5 to print labels or tags with a single click. Label template, and number of copies are defined in User Preferences.

VIII. FOP-6, Attachment 2

Chain-of-Custody Form, Sample Tag, Custody Seal

EPA USEPA Contract Laboratory Program Generic Chain of Custody

Reference Case:

Client No: 04CK01

R

Region: 5	Date Shipped: 08/30/2004	Chain of Custody Record	Sampler Signature: <i>Joe Sampler</i>
Project Code: TGB 102	Carrier Name: FedEx	Relinquished By (Date / Time)	Received By (Date / Time)
Account Code: ILD000902827	Airbill: 1234567890	1 <i>Joe Sampler 8/30/04 1845</i>	
Spill ID: 0528	Shipped to: Any Lab	2	
Site Name/State: OMC Plant 2/IL	1234 West 5th Street	3	
Project Leader: Jane Sitomanagar	Suite 99	4	
Action: Remedial Investigation	Whatever MN 55999		
Sampling Co: CH2M HILL	(000) 111-2345		

SAMPLE No.	MATRIX/ SAMPLER	CONCY TYPE	ANALYSIS/ TURNAROUND	TAG No./ PRESERVATIVE/ Bottles	STATION LOCATION	SAMPLE COLLECT DATE/TIME	QC Type
04CK01-12	Ground Water/ JOE SAMPLER	L/G	BTEX (21)	512352 (HCL), 512353 (HCL), 512354 (HCL) (3)	OMC-MW01S-01	S: 08/30/2004 13:30	

Shipment for Case Complete? <input type="checkbox"/>	Sample(s) to be used for laboratory QC:
Analysis Key:	Concentration: L = Low, M = Low/Medium, H = High
BTEX = (Benzene, Toluene, Ethylbenzene, Xylenes)	

TR Number: 5-484657676-051304-0004

PR provides preliminary results. Requests for preliminary results will increase anal;
Send Copy to: Sample Management Office, 2000 Edmund Haley Dr., Reston,

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION V
OFFICIAL SEAL
No. 136607

Station Number and Location	Month/Day/Year/Time	DESIGNATE Comp Grab
Tag Number	Number	Samplers (signatures) <i>Joe Sampler</i>
Remarks:	Sample Number: 04CK01-12 Station Location: CLP TCL Volatiles ANALYSIS: CLP TCL Volatiles Sample Date/Time: 08/30/2004/ 13:30 Matrix: Ground Water Preservative: HCL Sampler(s): JOE SAMPLER Tag Number: 512345	
USE FOR MINSO Lab Sample Number	ANALYSIS HCL <input type="checkbox"/> HNO <input type="checkbox"/> H ₂ O <input type="checkbox"/> ICE <input type="checkbox"/> METALS PRESERVATIVE: H ₂ O <input type="checkbox"/> HNO <input type="checkbox"/> H ₂ O <input type="checkbox"/> Other <input type="checkbox"/>	
	- number: 0606, 136607	
	Shipment lost? <input type="checkbox"/>	

REGION COPY

FVS1.063 Page 1 of 1

Site Logbook

I. Purpose

General guidelines are provided for keeping a site logbook.

II. Scope

The site logbook is a controlled document that records all major onsite activities during a remedial action. At a minimum, the following activities/events should be recorded in the site logbook:

- Arrival/departure of site visitors
- Weather conditions
- Arrival/departure of equipment
- Calibration notes
- Field parameter measurements
- Start or completion of sampling activities, borehole/trench/monitoring, well installation, etc.
- Health and Safety issues – note that the project Health and Safety Plan (HSP) specifies all documentation requirements

The site logbook becomes part of the permanent site file. Because information contained in the site logbook may be admitted as evidence in cost recovery or other legal proceedings, it is critical that this document be properly maintained.

III. Equipment and Materials

Bound notebook with consecutively numbered pages that cannot be removed

IV. Procedures and Guidelines

1. Dedicated site logbook(s) is maintained for each site
2. Site logbook is initiated at the start of the first on-site activity
3. Site logbook cover contains the following information in indelible ink:
 - Project name and EPA Work Assignment Number
 - Project Number

- Site Manager's Name
 - Sequential Book Number
 - Start Date
 - End Date
4. Entries are made every day that on-site activities occur
 5. At the beginning of each day, the following information must be recorded:
 - Date
 - Start time
 - Weather conditions
 - List all personnel present
 - List all visitors present
 - List topics discussed at health and safety meetings and attendees (for complete list, see HSP)
 6. Record summary of daily site activities and level of personal protection required
 7. Refer to other project notebooks being kept onsite (e.g., sample logbook, geologists notebook, health and safety officer's notebook, etc.).
 8. Record site measurements and equipment use in site logbook or reference logbook where this information is recorded.
 9. All entries should be made in ink. No erasures are permitted. Incorrect entries should be crossed out with a single strike mark and initialed.
 10. All photographic documentation must be logged into the logbook with a full description of each record and its key points of interest. Video tape, slides, or photographs taken on site or at monitoring locations should be numbered to correspond to logbook entries. Photographic records should also include name of photographer, date, time, site location, site description, and weather conditions.

V. Attachments

None.

VI. Key Checks and Items

- Logbook is initiated with the first on-site activity
- Logbooks must be sequentially numbered without removable pages
- All site activities are recorded
- Entries must be made daily

Decontamination of Personnel and Equipment

I. Purpose

To provide general guidelines for the decontamination of personnel, sampling equipment, and monitoring equipment used in potentially contaminated environments.

II. Scope

This is a general description of decontamination procedures.

III. Equipment and Materials

- Distilled water
- 2.5-percent (W/W) Alconox[®], Liquinox[®], or equivalent phosphate-free detergent and water solution
- 10-percent methanol solution (DO NOT USE ACETONE)
- Large plastic pails or tubs for Alconox[®], Liquinox[®], or equivalent and water, scrub brushes, squirt bottles for detergent solution, methanol and water, resealable plastic bags and sheets
- Pesticide grade methanol
- DOT approved 55-gallon drum for disposal of waste
- Unpowdered chemical-resistant gloves
- Decontamination pad and steam cleaner/high pressure cleaner for large equipment

IV. Procedures and Guidelines

Personnel Decontamination

To be performed after the completion of tasks whenever the potential for contamination exists, and also upon leaving the exclusion zone.

1. Wash boots in detergent solution, then rinse with water. If disposable latex booties are worn over boots in the work area, remove and discard into a DOT-approved 55-gallon drum.
2. Remove and discard outer chemical-resistant gloves into a DOT-approved 55-gallon drum.
3. Remove disposable coveralls ("Tyveks") and discard into a DOT-approved 55-gallon drum.
4. Remove respirator (if worn).

5. Remove inner gloves and discard.
6. At the end of the work day, shower entire body, including hair, either at the work site or at home.
7. Sanitize respirator if worn.

Sampling Equipment Decontamination—Groundwater Sampling Pumps

Sampling pumps are decontaminated after each use as follows:

1. Wear unpowdered chemical-resistant gloves.
2. Spread plastic on the ground to prevent hoses from touching the ground.
3. Turn off the pump after sampling. Remove the pump from the well, and place it in a decontamination sleeve/tube, making sure that any tubing does not touch the ground.
4. Turn the pump back on, and pump 1 gallon of detergent solution through the sampling pump.
5. Rinse with 1 gallon of 10-percent isopropyl alcohol solution pumped through the pump. (DO NOT USE ACETONE).
6. Rinse with 1 gallon of potable water.
7. Rinse with 1 gallon of distilled water.
8. Keep decontaminated pump in decontamination tube or remove and wrap in aluminum foil or put in new resealable plastic bag.
9. Collect all rinsate and dispose of in a DOT-approved 55-gallon drum.
10. Decontamination materials (e.g., plastic sheeting, tubing, etc.) that have come in contact with used decontamination fluids or sampling equipment will be disposed of in DOT-approved 55-gallon drums.

Sampling Equipment Decontamination—Other Equipment

Reusable sampling equipment is decontaminated after each use as follows:

1. Wear unpowdered chemical-resistant gloves.
2. Rinse and scrub with potable water.
3. Wash all equipment surfaces that came into contact with the potentially contaminated soil/water with detergent solution.
4. Rinse with potable water.
5. Rinse with distilled water.
6. If equipment has come in contact with oil or grease, rinse the equipment with pesticide-grade methanol followed by pesticide-grade methanol (DO NOT USE ACETONE), and then distilled water.

7. Completely air dry or wipe dry with a clean paper towel. Wrap exposed areas with aluminum foil (shiny side out) or enclose equipment in clean plastic for transport and handling if equipment will not be used immediately.
8. Collect all rinsate and dispose of in a DOT-approved 55-gallon drum.
9. Decontamination materials (e.g., plastic sheeting, tubing, etc.) that have come in contact with used decontamination fluids or sampling equipment will be disposed of in DOT-approved 55-gallon drums.

Health and Safety Monitoring Equipment Decontamination

1. Before use, wrap soil contact points in plastic to reduce need for subsequent cleaning.
2. Wipe all surfaces that had possible contact with contaminated materials with a paper towel wet with detergent solution, then a towel wet with alcohol solution, and finally two times with a towel wet with distilled water. Dispose of all used paper towels in a DOT-approved 55-gallon drum.

Sample Container Decontamination

The outside of sample bottles or containers filled in the field may need to be decontaminated before being packed for shipment or handled by personnel without hand protection. The procedure is:

1. Wipe container with a paper towel dampened with detergent solution, or immerse in the solution AFTER THE CONTAINERS HAVE BEEN SEALED. Repeat the above steps using potable water.
2. Dispose of all used paper towels in a DOT-approved 55-gallon drum.

Decontamination of Drilling Rigs and Equipment

Equipment and Materials

- Portable steam cleaner and related equipment
- Potable water
- Phosphate-free detergent such as Alconox® or Liquinox®
- Buckets
- Brushes
- Distilled water
- 10 percent isopropyl alcohol solution
- Methanol
- ASTM-Type II Reagent-Grade Water
- Aluminum foil

Drilling Rigs and Monitoring Well Materials

Before the onset of drilling, after each borehole, and before leaving the site, heavy equipment and machinery will be decontaminated using a phosphate-free detergent solution and high-pressure hot water at a designated area. The equipment shall then be rinsed with potable water. The steam cleaning area will be designed to contain

decontamination wastes and waste waters, and can be an HDPE-lined, bermed pad. A pumping system will be used to convey decontamination water from the pad to the drums.

Surface casings may be steam-cleaned in the field if they are exposed to contamination at the site before use.

Downhole Drilling Tools

Downhole tools will be decontaminated as described above (1) before the onset of drilling and (2) between boreholes. This will include rods, split spoons or similar samplers, coring equipment, auger bolts, augers, and casing.

Before the use of a sampling device such as a split-spoon sampler to collect soil samples for physical characterization or chemical analysis, the sampler shall be cleaned by scrubbing with a potable water/phosphate-free detergent solution, rinsing with potable water, and then rinsing with distilled water. If equipment has come in contact with oil or grease, rinse the equipment with methanol, and then distilled water.

V. Attachments

None.

VI. Key Checks and Items

1. Do not use acetone for decontamination.
2. Drum all contaminated rinsate.
3. Clean with solutions of Alconox[®], Liquinox[®], or equivalent phosphate-free detergent, isopropyl alcohol, and distilled water.

Monitoring Well Installation and Development

Purpose

The purpose of this FOP is to review well installation procedures. These procedures are to be considered general guidelines only, and are in no way intended to supplement or replace the contractual specifications in the driller's subcontract.

Scope

Installation of permanent groundwater monitoring wells in unconsolidated deposits.

Equipment and Materials

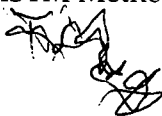
- Health and safety equipment
- YSI® multiprobe or equivalent instruments for measuring pH, temperature, specific conductance, and turbidity
- Storage for purge water
- Surge block
- Photoionization detector

Procedures and Guidelines

1. Monitoring wells will be installed in accordance with IEPA regulations.
2. The threaded connections will be watertight.
3. A record of the finished well construction will be compiled.
4. Soils and liquids generated during well installation and development will be drummed for proper disposal according to the Transportation and Disposal Plan.

Unconsolidated Well Installation (Hollow-Stem Auger Drilling Methods)

1. The monitoring wells will be installed using hollow-stem auger drilling methods. For the purposes of installing a 2-inch-diameter monitoring well, augers with at least a 4¼-inch inside diameter will be used. The monitoring well shall be sufficiently plumb and straight such that there is no interference with the utilization of sampling equipment.
2. While drilling, subsurface soil samples will be collected continuously from the ground surface to the bottom of the boring using 2-foot-long (minimum), split-barrel samplers advanced in accordance with ASTM Method D-1586-99.



3. After the augers have been advanced to the required depth and soil sampling is complete as specified by the onsite hydrogeologist, the monitoring well materials will be installed through the augers as specified in ASTM Method D-5784-95. Monitoring well materials will be dependent on the well location, depth, and subsurface conditions. If NAPL is suspected at the location, 2-inch-diameter, stainless-steel well screen and riser pipe with 0.010-inch slot, continuous wire-wrapped screen will be used. Wells installed where NAPL is not suspected will consist of Schedule 40, 2-inch-diameter PVC materials with 0.010-inch machine slotted 5-foot-length well screen flush-threaded to an appropriate length of flush-joined, riser pipe. A cap will be flush-threaded to the bottom of the well screen.
4. A sand filter pack, consisting of a washed and graded silica sand with at least 90 percent of the retained grain size greater than 0.010 inch, will be placed between the outside of the well screen and the borehole wall. A downhole tape measure will be used to assess the proper emplacement of the sand filter pack. The sand filter pack will extend from 6 inches below the bottom of the well screen to 2 feet above the top of the well screen.
5. A bentonite seal, consisting of bentonite chips or pellets, will be placed on top of the sand filter pack, and will be a minimum thickness of 2 feet and no greater than 3 feet. If the seal extends above the groundwater table, potable water will be used to hydrate the bentonite for a minimum of 2 hours before proceeding with the next step.
6. Following installation of the bentonite seal, the remaining annular space between the outside of the riser casing and the borehole wall will be filled with a cement/bentonite grout mixture. The grout mixture will be prepared in the following proportions: 94 pounds of cement (one bag) thoroughly mixed with about 6 gallons of water. Approximately 2 to 3 pounds of powdered bentonite per bag of cement will be added to reduce the amount of shrinkage as the grout cures. A premixed, high-solids grout (e.g., Aquaguard or Benseal) may also be used for annular seal grout.
7. For water table observation wells constructed in areas where the depth to the water table is less than 5 feet bgs, the required filter pack height above the top of the well screen may be reduced to 6 inches to allow for the placement of the required amount of annular space sealant.
8. A locking compression plug will be inserted into the top of the riser casing. A flush-mounted protective casing will be installed over the top of the riser casing and cemented in place.
9. Monitoring well specifications will be recorded on a monitoring well construction form. An example of this form is attached.
10. Excess drill cuttings will be contained in labeled, 55-gallon drums staged as designated in the Transportation and Disposal Management Plan.

Well Development

Subsequent to installation, the monitoring wells will be developed to remove fine-grained materials that may have settled in and around the well screen during installation, and to maximize the ability of the well to transmit representative portions of groundwater. Well

development activities will be conducted a minimum of 24 hours after completion of well installation activities to allow the cement around the well to cure.

Well development will be completed using an appropriate method such as a low-yield, submersible pump. Development will be accomplished by surging the well screen with a surge block, followed by purging the suspended sediments. Water quality parameters such as pH, temperature, and specific conductance will be periodically monitored during development to assess stabilization of these parameters. Well development will continue until the well yields relatively sediment-free water and/or the monitored water parameters have stabilized. These parameters are considered stabilized when pH measurements agree within 0.5 unit, temperature measurements agree within 1°C, and specific conductance measurements agree within 10 percent. A well development record will be maintained by the onsite hydrogeologist to document the well development methods used, the estimated volume of water purged, and the results of the water quality parameters monitored.

Fluids generated during well development activities will be contained in labeled, 55-gallon drums staged as designated in the IDW Management Plan. Development water may also be transferred into bulk storage poly tanks. Equipment used during well development will be decontaminated between monitoring well locations in accordance with FOP-17, *Decontamination of Drilling Rigs and Equipment*.

Attachments

- Illinois Administrative Code 920.170
- Soil Boring Log
- Well Completion Diagram
- Well Development Log

References

ASTM Method D-5784-95.

Key Checks and Items

None.



PROJECT NUMBER	BORING NUMBER	SHEET	OF
SOIL BORING LOG			

PROJECT :		LOCATION :	
ELEVATION :	DRILLING CONTRACTOR :		
DRILLING METHOD AND EQUIPMENT USED :			
WATER LEVELS :	START :	END :	LOGGER :

[illegible]

Joint Committee on Administrative Rules

ADMINISTRATIVE CODE

TITLE 77: PUBLIC HEALTH PART 920 ILLINOIS WATER WELL CONSTRUCTION CODE CHAPTER I: DEPARTMENT OF PUBLIC HEALTH SECTION 920.170 MONITORING WELLS

Section 920.170 Monitoring Wells

This Section shall apply to all monitoring wells, except those wells installed to monitor chemicals leaking from underground storage tanks which are installed within the excavation made for the installation of the underground storage tank.

- a) **Casing.** All monitoring wells shall have casing which meets the requirements of Section 920.90(a), except where the design specifications require the use of another material. Threaded joints shall be required where plastic casing is used. Casing must be clean, free of rust, grease, oil or contaminants and be composed of materials, including but not limited to steel and plastic, that will not affect the quality of the water sample. All casing shall be watertight. The casing shall be centered in the borehole, be free of any obstructions and allow sampling devices to be lowered into the well.
- b) **Well Screen.** All monitoring well screens shall be constructed of non-corrosive and non-reactive material. All well screens shall be permanently joined to the well casing and shall be centered in the borehole.
- c) **Filter Packs.** All monitoring wells installed in unconsolidated material shall be constructed with filter packs. When used, the filter pack shall be the only material in contact with the well screen.
 - 1) The filter pack shall consist of sand or gravel. The sand or gravel used for filter packs shall have an average specific gravity of not less than 2.50. The filter pack material shall be sized to match the screen slot size and the surrounding formation to prevent the formation materials from entering the screen. The sand or gravel shall be free of clay, dust and organic matter. Crushed limestone, dolomite or any material containing clay or any other material that will adversely affect the performance of the monitoring well shall not be used as filter pack.
 - 2) **Installation.** The filter pack shall extend a maximum of 6 inches below the bottom of the screen to 2 feet above the top of the screen. For water table observation wells constructed in areas where the depth to the water table is less than 5 feet, the required filter pack

height above the top of the well screen may be reduced to 6 inches to allow for the required amount of annular space sealant to be placed.

- d) **Grouting Requirements.** All materials and procedures used in the installation of annular seals for groundwater monitoring wells shall meet the requirements of this Section. The annular sealing material above the filter pack shall prevent the migration of fluids from the surface and between aquifers. Sealing material shall be chemically compatible with anticipated contaminants.
- 1) **Annular Space Seal.** All monitoring wells shall be installed with an annular space seal. The annular seal shall extend from the top of the filter pack to the surface.
 - 2) **Above Ground Surface Completion.** Where the monitoring well does not terminate flush with the ground surface in accordance with Section 920.170(d)(3), the casing shall extend at least 8 inches above the ground surface. The top of the casing shall be provided with a locking cap. If the monitoring well is located in a floodplain, the cap shall be watertight. Protective devices, such as rings of brightly colored posts around the well, shall be installed in areas where the casing is likely to be struck by farm vehicles or by individuals who are unaware of the existence of the well.
 - 3) **Ground Surface Completion.** Monitoring well casing may terminate at the ground surface provided a flush-mounted well completion pipe is installed over the casing. The flush-mounted completion pipe shall consist of a metal casing at least four inches larger in diameter than the well casing. Monitoring wells terminating at the surface may be allowed only in areas traveled by vehicles. The flush-mounted well completion pipe shall have a water tight seal and the annular opening around the well completion pipe shall be grouted. The well casing shall be sealed with a watertight locking cap.
- e) **Drilling Methods and Fluids.** The drilling method shall introduce the least possible amount of foreign material into the borehole, produce the least possible disturbance to the formation and permit the proper construction and development of the required diameter well. Water from a source free of bacterial and chemical contamination shall be used in the drilling fluid mixture.
- f) **Disposal and Decontamination.**
- 1) All drill cuttings and fluids and surge and wash waters from borehole and monitoring well construction and development shall be disposed of in a manner which will not result in contamination of the immediate area or result in a hazard to individuals who may come in contact with these materials.
 - 2) All monitoring well construction equipment shall be decontaminated

by washing and triple rinsing or high pressure heat cleaning to prevent cross-contamination of monitoring wells or in accordance with design specifications, whichever is more stringent.

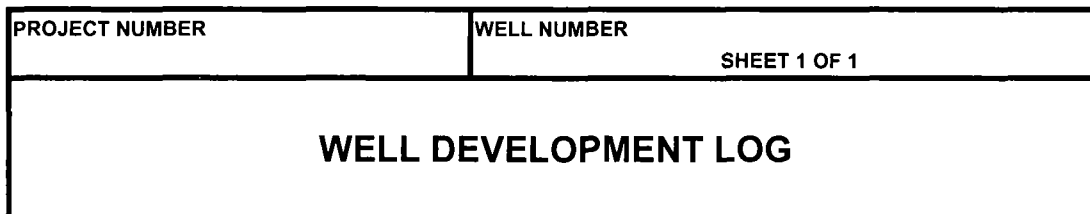
g) Special Circumstances and Exceptions.

- 1) The Department may require more restrictive or alternative well material, assembly or installation if the contaminant concentrations or geologic setting require alternative construction.
- 2) Variances to the requirements of this subsection may be approved by the Department prior to installation or abandonment. A variance request shall state the reasons why compliance with the rule is impractical or impossible. The Department shall approve a variance when it can be shown that the particular contaminant or drilling method requires alternative materials or procedures to safeguard against contamination of the groundwater.

h) Abandonment or Decommissioning of Monitoring Wells. All abandoned monitoring wells shall be sealed in accordance with Section 920.120.

- i) Reporting. Within 30 days after a monitoring well has been constructed or abandoned, the owner, designer or consulting firm shall submit a report of construction or abandonment to the Department on such forms as are prescribed and furnished by the Department.

(Source: Amended at 18 Ill. Reg. 17684, effective November 30, 1994)



MAXIMUM DRAWDOWN DURING PUMPING: _____

RANGE AND AVERAGE DISCHARGE RATE: _____

TOTAL QUANTITY OF WATER DISCHARGED: _____

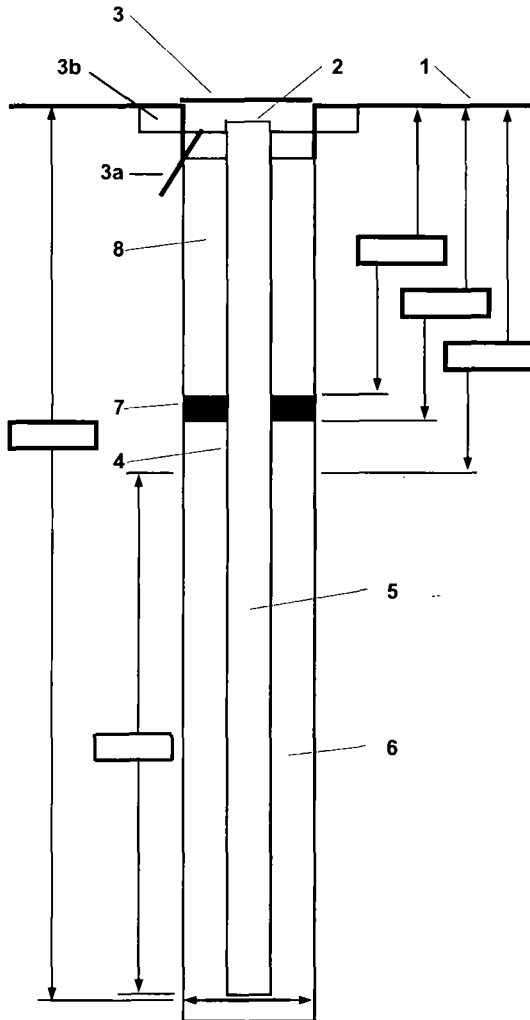
DISPOSITION OF DISCHARGE WATER: _____

[illegible]



PROJECT NUMBER	WELL NUMBER
SHEET 1 OF 1	
WELL COMPLETION DIAGRAM	

PROJECT :	LOCATION :
DRILLING CONTRACTOR :	
DRILLING METHOD AND EQUIPMENT USED :	
WATER LEVELS :	START :
	END :
	LOGGER :



1- Ground elevation at well	
2- Top of casing elevation	
3- Wellhead protection cover type	
a) drain tube?	
b) concrete pad dimensions	
4- Dia./type of well casing	
5- Type/slot size of screen	
6- Type screen filter	
a) Quantity used	
7- Type of seal	
a) Quantity used	
8- Grout	
a) Grout mix used	
b) Method of placement	
c) Vol. of well casing grout	
Development method	
Development time	
Estimated purge volume	
Comments	

Appendix B
Data Management Plan

DATA MANAGEMENT PLAN

**Final Design for Remediation of Groundwater Trichloroethene
and Dense Non Aqueous Phase Liquid**

**OMC Plant 2 Site
Waukegan, Illinois**

WA No. 020-RDRD-0528 / Contract No. EP-S5-06-01

December 2009

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GIS Description	3
Documentation	4
Evidence File	4
Presentation of Site Characterization Data	4

Abbreviations and Acronyms

COC	chain of custody
DMP	Data Management Plan
DMS	Data Management System
EDD	electronic data deliverable
GIS	Geographic Information System
QA	quality assurance
QC	quality control
SM	site manager

Data Management Plan

The Data Management Plan (DMP) outlines the procedures for storing, handling, accessing, and securing data collected during this sampling event. Data gathered will be consolidated and compiled into the project database system that can be used to evaluate site conditions and data trends. This DMP will serve as a guide for all database users. The DMP is subject to future revision to allow the database management system to be modified as it is developed and maintained. This plan describes the following:

- Responsibilities of the project team for data management
- Data Management System (DMS) to be established for the project
- Development of the base maps onto which the data will be plotted
- Types of data that will be entered into the DMS and the process of data entry

Team Organization and Responsibilities

The following are the team members and their responsibilities for the data management process:

- Project Chemist – Responsible for providing the chain-of-custody (COC) forms weekly and establishing the sample tracking system. Oversees proper use of the United States Environmental Protection Agency's (USEPA's) Field Operations Reporting Management System (FORMS) II Lite system and accuracy of the information entered. Reviews lab data for accuracy and quality and compares electronic outputs for accuracy to lab hard copies. Conducts sample tracking, forwards tracking information and received data to the database manager, and identifies the data inputs (for example, sample numbers) to use in generating tables and plots.
- Database Manager – Responsible for setting up the DMS in consultation with the project chemist at the beginning of the data evaluation task. Also oversees the data management process including data conversion and manual entry into DMS, quality control (QC) of the entered data, and preparation of the required tables and plots of the data. Coordinates with person responsible for reviewing the entered data for QC purposes. Forwards all deliverables to the site manager (SM).
- Geographic Information System (GIS) Manager – Responsible for coordinating with the SM to set up the geodatabase prior to sampling. Maintains spatial layers and overall geodatabase integrity and accuracy. Provides all GIS-related outputs for reports.

Sample Tracking

The project chemist is responsible for tracking samples in the sample tracking database to ensure the analytical results for all samples sent for analysis are received. Copies of COCs from the field team are used to enter in sample identification numbers, collection dates, and analyses. Upon receipt of a sample receipt notice from the laboratory, the date received by

the lab and a date the hard copy is due will be entered. Likewise, upon receipt of the hard copy and electronic data deliverables (EDDs), the date they were received will also be entered. The date the data are sent to USEPA for validation and the date validation reports are delivered to CH2M HILL will be recorded. The EDD will be uploaded when received from the lab, and tracked in the sample tracking table. Validation qualifiers will be added to the database and results qualified accordingly.

Data Types

The Quality Assurance Project Plan, of which this DMP is a part, identifies additional data to be collected for cleanup verification. The data to be collected during the remedial action is described in the QAPP.

These data will be added to the project database as they become available. The data will include new data collected in the laboratory and validated by USEPA or CH2M HILL. The data source will be noted in the database. Procedures for incorporating the data into the database are presented in subsequent sections of this DMP.

Data Tracking and Management

Every data set received from the analytical laboratories will be tracked individually. Analytical laboratory reports of chemical analysis results will be tracked in a consistent manner. Every data set will be assigned a unique identifier. The date of receipt, status of data validation, and status of database entry for each data set will all be tracked and recorded in the project database.

Hard Copy

Measurements made during field data collection activities will be recorded in field logbooks. Field data will be reduced and summarized, tabulated, and stored along with the field logbooks.

All raw analytical laboratory data are stored as the original hard copy. Hard copy information includes COC forms, analytical bench sheets, instrument printouts and chromatograms, certificates of analyses, and quality assurance/quality control (QA/QC) report summaries. Validation reports will be stored with the hard copy reports.

Data Input Procedures

Sampling information, analytical results, applicable QA/QC data, data validation qualifiers, and other field-related information will be entered into the project database for storage and retrieval during data evaluation and report development. The analytical data will be loaded into the database using EDD files received from the analytical laboratory. Validation qualifiers will be entered manually. Validators will confirm correct data entry by printing validated data reports from the database and manually comparing them to the validated summary analytical forms received from USEPA. Other available field-related data collected, such as water levels or newly installed well information, will be manually entered into standard EDD templates for loading into the database. Historical data, either in hard copy or electronic form, will be manually entered on or formatted to standard EDD templates for database loading. The entry of other field-related data and historical site data will be confirmed by comparing the hard

copy printouts from the database against the hard copies used to perform the data entry. All data entry confirmation procedures and results will be documented.

Computer Database

The technical data, field observations, laboratory analytical results, and analytical data validation will be managed using EQuIS®, a third-party database system by Earthsoft, Inc., that is used in USEPA Region 5 to store and analyze project data submissions. The core EQuIS® applications are its chemistry and geology modules, each of which is associated with its own underlying Microsoft Access database. CH2M HILL owns licenses for the geology and chemistry modules. The EQuIS® database system is based on a relational model, in which independent tables, each containing a certain type or entity of data, can be linked through selected fields that are common to two or more tables. This database design allows for the inclusion of historical data, and allows users to effectively conduct trend analyses and generate a variety of data reports to aid in data interpretation.

The database must be protected from unauthorized access, tampering, accidental deletions or additions, and data or program loss that can result from power outages or hardware failure. The following procedures will be adopted to ensure this protection:

- The master database will be stored on a network file server local to the installation of the EQuIS® data management system. Members of the data management team involved in loading, modifying, or querying the database will be given access through EQuIS® user accounts and passwords, as well as the appropriate network server permissions.
- Copies of the master database will be stored on the local area network for access by project staff through reporting tools developed to minimize possible database corruption by users. Whenever the master database is updated or modified, it will be recopied to the local area network to ensure that the current copy is available to users.
- Daily backups of the master database and its copies will be made to ensure that the data will not be lost because of problems with the network.

GIS Description

A project geodatabase will be agreed upon and set up prior to sampling by the SM, database manager, and GIS manager. Workflow for creating, maintaining, and organizing geospatial data will follow the Spatial Data Standard format for projects, whenever possible.

An ArcView project or extension will be used providing the following functionality: load and display project site basemaps, display sampling station locations and associated sampling data (date, media, results), and perform ad hoc queries to highlight sampling locations meeting user-entered criteria for sampling (for example, data by date, sample type, analyte, depth/elevation, result value, or any combination thereof). Results will be shown as stations highlighted on the map.

Documentation

Documentation of data management activities is critical because it provides the following:

- A hard copy record of project data management activities
- Reference information critical for database users
- Evidence that the activities have been properly planned, executed, and verified
- Continuity of data management operations when personnel changes occur

The DMP will serve as the initial general documentation of the project data management efforts. Additional documentation will be maintained to document specific issues, such as database structure definitions, database inventories, database maintenance, user requests, database issues and problems, and client contact.

Evidence File

The final evidence file will be the central repository for all documents that constitute evidence relevant to sampling and analysis activities. CH2M HILL is the custodian of the evidence file and maintains the contents of the evidence files for the project, including all relevant records, reports, logs, field notebooks, pictures, contractor reports, and data reviews in a secured area with limited access.

CH2M HILL will keep all records until project completion and closeout. As necessary, records may be transferred to an offsite records storage facility. The records storage facility must provide secure, controlled-access records storage. Records of raw analytical laboratory data, QA data, and reports will be kept by the subcontracted laboratory for at least 7 years.

Presentation of Site Characterization Data

Depending on data user needs, data presentation may consist of any of the following formats:

- Tabulated results of data summaries or raw data
- Figures showing concentration isopleths or location-specific concentrations
- Tables providing statistical evaluation or calculation results
- Presentation tools, such as ARCINFO or similar analysis or presentation aids

In addition to laboratory data, other physical data will be collected during field efforts. This information will be stored in the project database. Other types of data elements may be added as the field investigation needs and activities evolve.